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Office of Healthy Homes and Lead Hazard Control

A Review of Currently Available Lead-Based Paint Encapsulants and Use Patterns in the Control of Residential Lead-Based Paint Hazards

March 2003

Final Report

**A REVIEW OF
CURRENTLY AVAILABLE LEAD-BASED PAINT ENCAPSULANTS AND
USE PATTERNS IN THE CONTROL OF RESIDENTIAL LEAD-BASED
PAINT HAZARDS**

for

**Office of Healthy Homes and Lead Hazard Control
U.S. Department of Housing and Urban Development
Washington, D.C. 20024**

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Battelle was responsible for designing the study, conducting the interviews with encapsulant users, conducting the site visits, performing analyses on the study data, developing the conclusions and recommendations derived from the analyses, and writing the final report.

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EXECUTIVE SUMMARY

This report summarizes the findings of a reconnaissance effort to determine the extent to which lead-based paint liquid encapsulants are currently being used for residential lead hazard control and to obtain an informal assessment of users' experiences with encapsulants. The effort included a literature search to identify and review the relevant literature on encapsulant use and performance, interviews with officials from states that were considered to be likely to regulate encapsulant use, surveys of major encapsulant users and other lead hazard control professionals, and site visits to selected users.

The most important outcome of the literature search is that there is no detailed discussion on the long-term performance of encapsulants in the published literature. In addition, technical reviews and theoretical discussions concerning the chemical composition of encapsulants and comparisons between various chemical alternatives are lacking in the published literature. In the past, there has been a difference of opinion among various encapsulant manufacturers and other professionals concerning the optimal properties of encapsulants; however, results of any research into these issues apparently have not been published. The only document that reported on the long-term effectiveness of encapsulation looked at cases where products had been installed for only two years.

Encapsulant manufacturers were identified from various state registries and other lists compiled between 1993 and 1997. New encapsulant manufacturers were sought out using Internet searches, personal contacts, exhibitor lists from lead conferences, and advertisements in various coatings journals and lead-oriented newsletters. Fifteen current manufacturers, which make 19 different encapsulant products, were identified as a result of this effort. Fifteen other manufacturers were determined to have been acquired by other companies or assumed to have gone out of this line of business. Potential encapsulant manufacturers were contacted in 2000, 2001, and 2003 to verify the commercial status of their products, to request product literature, and to identify any other manufacturer referrals.

Twenty-four states were contacted regarding their regulation of lead-based paint encapsulant products. Contacted states included those that are known to actively regulate encapsulants and those that are located in regions where dense populations and older housing stock have resulted in a historically higher incidence of lead-based paint usage and the subsequent passage of regulations. Twenty-two of the states responded that they do recognize encapsulant usage as an approved method of lead hazard control. Eleven of these states responded that they regulate encapsulant usage in some manner, while nine others indicated that, although they have no specific regulations, they expect contractors and homeowners to follow HUD and/or EPA guidelines if encapsulants are used. Eight of the states that regulate encapsulants have compiled lists of approved, permitted, authorized, or acceptable encapsulant products. Requirements for inclusion on a state list vary among states, but most states require that products be tested against and pass ASTM standards.

Interviews were conducted with selected encapsulant users and other lead hazard control professionals to inquire about their experiences with encapsulation as a viable lead-based paint

abatement technique. The intent of these small-scale surveys was to provide a general picture of encapsulant usage in the U.S.

Three groups of users were targeted for interviews: public housing agencies (PHAs), military installations, and private homeowners. Users were sought from all regions of the country. Encapsulant manufacturers' product literature collected during the first phase of the study provided the primary source for identifying PHAs to interview. Military installations that use encapsulants were primarily identified from work being conducted by the U.S. Army's Construction Engineering Research Laboratory. Identifying private homeowners to interview proved to be an extremely difficult task, and the few that were found were a result of assistance received from the redevelopment authority in Savannah, Georgia.

In all, 47 PHAs, 14 military installations, and two private homeowners were interviewed for this report. Approximately half of the interviewed PHAs and military installations reported using encapsulants. The majority of users that have applied encapsulants are satisfied with how the products have performed.

Abatement contractors, risk assessors, trainers, engineers, and other professionals in the lead hazard control field also were interviewed. The primary source of potential respondents for this effort was a HUD-sponsored website (www.leadlisting.org) that provides the public with lists of certified lead professionals. Representatives from national groups such as the National Lead Assessment and Abatement Council (NLAAC) also were interviewed. Twenty-two lead hazard control professionals participated in interviews. Just over half of these professionals stated that they recommend encapsulant usage to their clients. In addition, they reported that they have access to the information necessary to make educated decisions regarding possible encapsulant usage for their clients' projects.

In general, encapsulant usage was found to be greater in the eastern half of the U.S., which has a higher prevalence of older housing with lead-based paint, a longer history of encapsulant usage, and more state laws that may stimulate usage. Potential users in the western states are less familiar and knowledgeable about encapsulant products. Among the military installations, the U.S. Army appears to embrace encapsulant usage more widely than the other branches of the military.

Site visits were conducted for the purpose of evaluating what data might be available in the field should HUD decide to conduct a long-term study of encapsulant performance in the future. Five sites were selected based on a variety of factors including: age of encapsulant, encapsulant product used, components encapsulated, geographic region, and possibility that the site would be a good candidate for a future long-term study.

Five encapsulants were evaluated during the site visits, and the length of time they had been applied ranged from one to fifteen years. Substrates that had been encapsulated included wood, metal, brick, cut stone, plaster, and concrete; while encapsulated components included walls, ceilings, windows, door frames, stair risers, and porch posts. Investigation of the encapsulants was limited to visual inspection of components.

For the most part, the encapsulants evaluated during the site visits appeared to be in excellent condition. In particular, the interior encapsulants (three significantly different types) exhibited superb performance since their applications between seven and fifteen years ago.

Although this survey was not based on a statistically representative sample from all users and lead hazard control professionals throughout the country, survey results indicate some common themes across the various categories of users and professionals interviewed that provide a picture of the current state of encapsulant usage in the country. These themes include:

- Encapsulation is most often used when components cannot be replaced because of cost, liability, historical preservation, or structural concerns. If it is a feasible option, most users and professionals would rather remove components than encapsulate them.
- Users that have applied encapsulants are generally satisfied with their performance and would use them again in the future if the situation were appropriate.
- Professionals that advise others on encapsulant usage have access to the information necessary to make educated decisions.
- Some of the surveyed users and professionals in the western half of the country and in the Air Force feel that high quality paints are just as effective as encapsulants and that the extra cost of encapsulants does not justify their use.

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1.0 INTRODUCTION

Childhood lead poisoning has been recognized as one of this country's most important environmental health problems. Exposure of children under the age of six to significant amounts of lead can cause a variety of health problems, perhaps the most common and notable of which is irreversible central nervous system damage resulting in learning and behavioral disabilities. As a result, Congress enacted the Residential Lead-Based Paint Hazard Reduction Act of 1992 (42 U.S.C. 4851). This act and other regulatory, policy, educational, and research initiatives are aimed at eliminating childhood lead poisoning.

One significant source of lead in many childhood environments is deteriorating lead-based paint. Lead was a common pigment of paint that was manufactured in the early part of the 20th century. The use of lead in residential paint began to decline around WWII, however did not stop until 1978, when lead pigment was essentially banned for residential use by the Consumer Product Safety Commission (16 CFR Part 1303). Many older housing structures, particularly many built before 1950, may contain significant amounts of lead-based paint, some of which is in poor condition. When this paint deteriorates, it distributes fine particles of lead which contaminate household dust and exterior soil. This dust and soil can then be accidentally ingested by young children through their normal hand-to-mouth and play activities (EPA, 2000).

The U.S. Department of Housing and Urban Development (HUD) estimates that 25 million homes in the U.S. have deteriorated lead-based paint (HUD, 2001). Abating the lead-based paint in these homes is crucial to achieving the nation's goal of eliminating lead-based paint hazards in housing where children live and eliminating elevated blood-lead levels in children by 2010 (HUD/EPA, 2000). However, abating these hazards can be expensive. HUD has provided hundreds of millions of dollars since 1993 to cities, counties, and states to treat lead-based paint hazards in their communities and to educate their citizens about preventing lead-based paint poisoning. Many more other government and private dollars also have been spent in an attempt to address this problem.

Both HUD and the U.S. Environmental Protection Agency (EPA) have published rules that define what constitutes abatement of lead-based paint hazards. According to §35.110 under 24 CFR Part 35 (HUD's Lead Safe Housing Rule) and §745.223 under 40 CFR Part 745 (EPA's Training, Certification, Accreditation, and Standards for Lead-Based Paint Activities rule – known as the 402/404 rule), lead abatement is defined as any set of measures that have an expected design life of at least 20 years and that are designed to eliminate lead-based paint or lead-based paint hazards. Based on these rules, HUD recommends in its *HUD Guidelines* (HUD, 1995) that encapsulation be considered an acceptable method of abatement provided, among other things, that the manufacturer warrants that the product, if applied correctly, will remain effective for at least 20 years. Various other abatement options for treating lead-based paint have been developed and are currently in use. Table 1 provides descriptions of the major abatement methods, as well as a comparison of their advantages and disadvantages.

Table 1. Comparison of Lead-Based Paint Abatement Methods

Abatement Method	Description	Advantages	Disadvantages
Component replacement	Removal of items that are coated with lead-based paint and replacement with new lead-free components	Permanent solution, minimizes worker and resident exposure	Can be expensive, generates large amounts of waste (possibly hazardous), not allowed in some historic preservation projects
Paint removal	Removal of paint from components using a variety of methods (e.g., wet scraping, HEPA sanding, HEPA needle blasting, chemical stripping, heat guns)	Permanent solution, can be used in historic preservation projects	Can release significant amount of dust, generates hazardous waste, may use caustic chemicals, specialized equipment may be necessary
Enclosure system	Mechanical attachment of a rigid barrier (e.g., drywall, paneling, siding) over lead-painted components	Uses standard construction materials, durable, produces minimal waste, minimizes lead dust	Vulnerable to water and physical damage, future renovations may re-expose lead-based paint, cannot be used in unsound structures
Encapsulation	Covering of component with durable coating system	Does not generate lead dust, relatively inexpensive, wide range of products available	Inappropriate for use on friction surfaces, durability depends on condition of underlying substrate and paint, susceptible to water damage

Encapsulation is a process that makes in-situ lead-based paint inaccessible through the use of a durable coating system that provides a barrier between the paint and the environment. The lead encapsulant industry categorizes encapsulants as non-reinforced or reinforced liquid coatings. Reinforced encapsulants are those that incorporate a fabric, mat, or mesh reinforcement with a polymeric or cementitious coating, while non-reinforced encapsulants are coatings applied without the use of a reinforcing material. Both the non-reinforced and reinforced categories contain encapsulants which are intended to be used on interior, exterior, or interior/exterior surfaces. The American Society for Testing and Materials (ASTM) has published three standards that specify minimum requirements that liquid encapsulant products must meet and that provide guidance on how to select and use an appropriate encapsulant (ASTM, 1997).

Although encapsulation is a particularly attractive option in some situations because encapsulants are easy to apply, are minimally disruptive to occupants, and are inexpensive compared to other abatement methods, limited published information is available on their long-term durability. The first lead-based paint encapsulants were marketed around 1980, and thus have not been in existence long enough to yield much data on how they hold up in the field over 20 years or more. In addition, no published study has looked strictly at the performance of lead-

based paint encapsulants. Factors such as environmental conditions (e.g., rain, heat, cold) to which the encapsulants are exposed, how well the encapsulant was originally applied (e.g., was it applied over old flaking paint; was the surface prepared correctly prior to application; was the product mixed according to manufacturer specifications?), how well the surface is maintained after the encapsulant is applied, the degree to which the surface is subjected to impact and abrasion, and the chemical characteristics of the encapsulant product itself are likely to affect the long-term effectiveness of encapsulants.

In order to address the lack of published information on encapsulant usage in the country, HUD's Office of Healthy Homes and Lead Hazard Control sponsored preliminary work that could be used as the basis for a possible future study on the long-term effectiveness of encapsulants. Such a study likely would involve the evaluation of how well encapsulants have held up over time at various sites across the country; however, another possibility would be to examine the performance of encapsulants scientifically exposed to accelerated weatherization and usage. In either case, it is important to understand how and where encapsulants are currently being used. As a result, HUD instigated this preliminary work in an effort to determine the extent to which encapsulants are currently being used for residential lead hazard control and to obtain an informal assessment of users' experiences with encapsulants. Following a literature search, the work involved the identification and interviewing of encapsulant users and other lead hazard control professionals. In addition, state government representatives were contacted to determine if and how they regulate lead-based paint encapsulants in their states. Finally, based on the information gathered during these interviews, five sites where encapsulants previously had been applied were visited to observe how well the encapsulants appeared to be performing.

This report summarizes the findings of the reconnaissance effort. Information gathered during the literature search; interviews with state government representatives; surveys of major encapsulant users and other lead hazard control professionals concerning their experiences with using encapsulation as a viable lead-based paint abatement technique; and site visits is included.

2.0 LITERATURE REVIEW

A literature search was performed in late 1999 to identify and review the relevant literature on encapsulant use and performance. Because of the limited amount of published work on encapsulant usage, relatively few publications were identified. The results of the literature search and the method by which it was conducted are presented below.

The first step in the literature search process was to perform some online searches in the EPA library system and the Allied Science and Technology database to determine the sets of keywords that would generate literature that could be used to identify manufacturers and users of encapsulants and identifiable sites where encapsulants had been used in the past. Based on these activities, a search strategy was developed to be used in the actual literature search. Table 2 lists the keywords that comprised this search strategy.

Table 2. Search Strategy Used in Literature Search

Level 1 keywords	Level 2 keywords	Level 3 keywords
lead paint leaded paint lead-based paint lead-containing paint	encapsulant encapsulate encapsulation	demonstration pilot study (ies) field study (ies) case study (ies) use field test maintenance study follow-up health safety

Fifty-seven electronic information databases were then searched. Sixteen of the databases contained one or more hits based on the search strategy. Records containing bibliographical information and abstracts for these hits were downloaded and reviewed, and documents of interest were then requested for the study.

After the documents had been read, only ten of them were determined to contain any pertinent encapsulant usage information (and even these ten were not completely focused on encapsulant use and performance). In addition, one journal article that was published after the literature search was completed was identified. Major findings specific to encapsulant usage from the articles are discussed below, and brief summaries of encapsulant information described in each article are presented in Table 3. A complete bibliography for these documents is included in Section 9.0.

The most obvious outcome of the literature search was that there is no detailed discussion on the long-term performance of encapsulants in the published literature. In addition, technical reviews and theoretical discussions concerning the chemical composition of encapsulants and comparisons between various chemical alternatives also were lacking from the published literature. In the past, there has been a difference of opinion among various encapsulant manufacturers and other professionals concerning the optimal properties of encapsulants

(e.g., very rigid versus flexible, etc.); however, results of any research into these issues apparently have not been published.

The few articles and government reports that even mentioned encapsulants were written about entire lead abatement studies which included encapsulation as one of the possible abatement methods (Buxton, et al, 1995; Eberle, 1995; Lai, et al, 1994; HUD, 1990; EPA, 1998). In these cases, the effectiveness and durability of the encapsulants after deployment were not discussed. Three other articles (Cohen, 1997; Duane, 1997; Leczynski, et al., 1995) described the possible uses and advantages of lead-based paint encapsulation products, but did not provide any information on their long-term performance. The only document that claimed to report on the long-term effectiveness of encapsulation looked at cases where products had been installed for only two years (EPA, 1996).

In the recently published article (Maty, 2000), Maty makes a case that the pending litigation against lead-based paint manufacturers has raised awareness among the general public concerning the issues related to lead-based paint. As a result of that publicity and the increased awareness of lead associated with the new disclosure regulations published by HUD and EPA (24 CFR 35 Subpart A and 40 CFR 745 Subpart F), Maty states that encapsulant manufacturers may now have increased market opportunities for encapsulant sales to homeowners. He further states that the key to taking advantage of these opportunities will be to build an effective advertising campaign that targets how encapsulant products can help protect children.

Table 3. Summary of Literature Search Findings

Author	Title	Date	Encapsulant Information Summary
Buxton, B.E., Rust, S.W., et al.	Results from the Pilot Comprehensive Abatement Performance Study	1995	Description of 1991 HUD Abatement Demonstration sites where encapsulants were applied. These could be candidates for a possible follow-up study of encapsulant performance.
Cohen, D.R.	Encapsulation Not Viable for all Lead Paint Jobs	1997	Provides some history of encapsulant use and guidelines. Concludes that if abatement is defined as eliminating the lead hazard, encapsulation is a solution. However, encapsulants should not be used on friction surfaces or surfaces that are not sound and intact; recommends monitoring annually.
Duane, K.	Encapsulants – Hot on the Trail of Protection	1997	General description of encapsulants. Liquid-applied encapsulants provide a barrier between lead-based paint and occupant; acceptable alternative to full-scale LBP abatement according to HUD; in use about 10 years.
Eberle, R.F.	The HUD Lead-Based Paint Abatement Demonstration in Public Housing	1995	Describes HUD Abatement Demonstration project: 172 vacant single-family housing units owned by FHA in seven cities & 109 multifamily public housing units owned by PHA were abated. Encapsulation was one method used.
Lai, F.S., Jwang, J.C., Ngwa, T.	Experimental Evaluation of Lead Encapsulation by Encapsulant Coating	1994	Liquid encapsulants were used in the HUD FHA Abatement Demonstration project but there were no standard methods for evaluating the durability and effectiveness of encapsulants (in the laboratory). Does not deal with durability or long-term effectiveness after deployment.
Leczynski, B.A., Schwemberger, J.G., Cramer, R.J.	Encapsulation of Lead-Based Paint	1995	Defines encapsulant product performance and protocols for use in lead abatement.
Markowitz, M.E., Bijur, P.E., Ruff, H.A., et al.	Moderate Lead Poisoning: Trends in Blood-Lead Levels in Unchelated Children	1996	Defines a visual rating scheme for interior paint surfaces (0-3) and XRF to give Home Environmental Score (HES): 0=intact; 1=bubbling; 2=cracking; 3=peeling surface [possible scale for visual rating of encapsulants and other coatings]

Table 3. Summary of Literature Search Findings (continued)

Author	Title	Date	Encapsulant Information Summary
Maty, J.	Lead-Paint Buzz Boosts Awareness of Cost-Effective Encapsulation Option	2000	Advocates that increased lead awareness, news-making litigation, disclosure regulations, and effective advertising may expand market opportunities for encapsulant sales to homeowners. Says that the 20-year performance requirements are easily met if surface is prepared properly before application.
U.S. Department of Housing and Urban Development	Comprehensive and Workable Plan for the Abatement of Lead-Based Paint in Privately Owned Housing: Report to Congress	1990	Describes encapsulation as an abatement method; identifies the HUD demonstration sites; describes the selection of HUD sites; calculates cost including labor for several methods of abatement; no evidence is reported to show whether enclosures are more durable than liquid encapsulants; describes state and city programs; FHA position on treatment of defective paint in residential units.
U.S. Environmental Protection Agency	Comprehensive Abatement Performance Study Volume I: Summary Report: EPA-230-R-94-013a	1996	Follow-up to HUD Abatement Demonstration activities in Denver, Colorado, to assess the long-term (two years) efficacy (dust-lead levels) of two abatement methods (encapsulation/enclosure versus removal); visual inspection of encapsulated surfaces rated them 60% intact after two years compared with surfaces abated by other methods, which were rated as 70% intact.
U.S. Environmental Protection Agency	Review of Studies Addressing Lead Abatement Effectiveness - Updated Edition: EPA-747-B-98-001	1998	Provides scale for rating paint condition (0,1,2,3). Reports studies of encapsulated paint but does not always distinguish use of liquid-applied encapsulants from "solid encapsulant materials" adhesively bonded to surface.

3.0 PRODUCT IDENTIFICATION

An attempt was made to identify all liquid encapsulant products currently on the market in the United States. Encapsulant manufacturers listed on various state registries and other lists compiled between 1993 and 1997 served as the basis for this effort. In addition, new encapsulant products were sought out using Internet searches, personal contacts, exhibitor lists from lead conferences, and advertisements in various coatings journals (e.g., *Journal of Protective Coatings and Linings*, *Modern Paints and Coatings*, *Journal of Coating Technology*, *Paints and Coatings Industry*) and lead-oriented newsletters (e.g., *Deleading*, published by the National Lead Assessment and Abatement Council). Potential encapsulant manufacturers were contacted by telephone to verify the commercial status of their products, to request product literature, and to identify any other prospective manufacturers.

When calls to the manufacturers could not be completed, reverse phone directories were used to verify whether the phone number still belonged to an encapsulant manufacturer. In cases where the old phone number no longer belonged to an encapsulant manufacturer, various sources were used in an attempt to locate a new phone number for the company. These sources included Yellow Pages and directory assistance for the cities associated with the old phone number, Internet searches using the company name (and product name if it was known), reference books that list U.S. companies (e.g., *CorpTech Directory of Technology Companies*, *Thomas Register*) and current state registries. If no new company contact information could be found using these sources, the company was assumed to have gone out of this line of business.

Table 4 lists the 15 current liquid encapsulant manufacturers that were identified as a result of this effort, as well as the 19 different products that they make (as of January 2003). Two companies that manufacture products that are closely related to encapsulants are listed in Table 5. Contact information for all 17 of these manufacturers is provided in Table A-1 of Appendix A. Comparing the current list of encapsulant manufacturers with older lists indicates that there has been considerable turnover in the encapsulant industry. Fifteen encapsulant manufacturers were determined to have been acquired by other companies or assumed to have gone out of business (shown in Table 6). On the other hand, only one new encapsulant manufacturer (SAFE Encasement Systems) was identified.

Table 4. Active Lead-Based Paint Liquid Encapsulant Manufacturers as of January 2003

Encapsulant Manufacturer	Encapsulant Product(s)
American Coatings Corporation	CC-2B
Coronado Paint Company	LEAD BLOCK™
Dumond Chemicals	LEAD STOP™
Dynacraft Industries, Inc.	Back To Nature Protect-A-Coat™ Back To Nature Exterior™
Encap Systems Corporation	EncapSeal™ I EncapSeal™ II
Fiberlock Technologies, Inc. ¹	Child GUARD interior/exterior L-B-C® Type III
Fox Industries	FX-499
Global Encasement, Inc.	LeadLock™
Grace Construction Products	Lead Seal® Barrier Coat® II
Grayling Industries, Inc.	CONTROL Multi-Use Encapsulant
hallman/lindsay Quality Paints	WHITE POLYMER #500
Insl-x Products Corporation	INSL-CAP™
Proko Industries	SAF-T-SHIELD®
SAFE Encasement Systems	SE-120 Protective Skin
Specification Chemicals, Inc.	NU-WAL® #2500 Coating

¹ As of January 2000, Fiberlock is manufacturing only the two products listed. Previous products (e.g., L-B-C® Type I, L-B-C® Type II, and LeadMaster®) will continue to be available until inventory is depleted.

Table 5. Manufacturers of Related Products That Are Not Liquid Encapsulants

Manufacturer	Comment
FLEXi-WALL Systems	Product literature refers to products (Plaster in a Roll™, Faster Plaster™) as encapsulants, but they do not meet the ASTM definition of a liquid encapsulant. The products are applied as a material that is adhesively affixed to the surface (somewhat similar to an enclosure); they are not applied as liquid coatings. Note that the State of Connecticut recognizes them as encapsulants because they are cementitious products that passed testing by the National Bureau of Standards.
Newtex Industries	Product (Newtex Wallcovering) is marketed as a fabric that can be used in conjunction with non-reinforced encapsulant products; by itself, the product cannot be considered to be an encapsulant.

Table 6. Previous Encapsulant Manufacturers That Are Not on Current List

Encapsulant Manufacturer	Comment
Advance Coatings and Spray, Inc.	Competitor stated that company went out of business.
AGP Surface Control Systems, Inc.	Old phone number did not work; could not find any current contact information.
Elasti-cote, Inc.	Stated that they no longer make a lead-based paint encapsulation product.
Empire Plastics, Inc.	Stated that they no longer make a lead-based paint encapsulation product; old product was actually an enclosure.
Encapsulation Technologies Corporation	Old phone number did not work; could not find any current contact information.
Fiber Tec Coatings Corporation	Old phone number did not work; could not find any current contact information.
Global Solutions	Old phone number did not work; could not find any current contact information.
ICI Paints - Devoe & Glidden	Stated that they no longer make a lead-based paint encapsulation product.
Kapsulkote	No longer in business.
LeadCover, Inc.	Acquired by Coronado Paint Company
Mateson Chemical Corporation	No longer in business.
Premier Coatings, Inc.	Acquired by Coronado Paint Company
Pyrocheck International Corporation	Old phone number did not work; could not find any current contact information.
Suretech	Old phone number did not work; could not find any current contact information.
STO Industries, Inc.	Old encapsulant product is still made and would be sold as an encapsulant if requested, but product is now marketed as an adhesive (STO Dispersion Adhesive); no attempts are made to sell it as a lead-based paint encapsulant due to inadequate market.

Current product literature was received from all of the identified encapsulant manufacturers. The type of information contained in the literature is similar for all products. Information includes: a product description, generic polymer type, statement of compliance with performance standards ASTM E 1795 and E 1797 (see Section 4.0 for details on ASTM standards), state approvals, surface preparation instructions, application instructions, warranty, monitoring/inspection/repair instructions, and safety and toxicity information.

The literature supplied by the encapsulant manufacturers contains little documentation concerning long-term performance of encapsulants. Some testimonials do refer to satisfaction with encapsulants applied in the early 1990s, but no specifics are included. Some manufacturers list sites where their encapsulant has been used in the past.

The standard encapsulant warranty is 20 years, but most manufacturers cover only the quality of the original encapsulant product as supplied and only if it was applied over a properly

prepared surface. Detailed instructions are supplied with each product concerning surface preparation. Coverage is usually limited to the cost of the encapsulant, not including labor.

Product literature usually points out that an encapsulant does not provide a barrier to the lead-based paint if the surface is abraded, broken, or damaged. Users are reminded to inspect encapsulated areas regularly to spot holes, cracks, water stains, blistering, or other damage. These damaged areas are to be repaired and re-coated with encapsulant. Chapters 5 (Lead-Based Paint Risk Assessment), 6 (Ongoing Monitoring), and 13 (Encapsulation) of the *HUD Guidelines* sometimes are cited as sources to follow for on-going monitoring and re-evaluation.

Using the information provided in the product literature, the 19 current encapsulant products were categorized by generic chemical type. The results of this categorization are presented in Table 7 and can be summarized as follows. Ten of the products are acrylic or acrylic copolymer latexes, two are copolymers that do not appear to contain acrylics, five are proprietary latexes that are not disclosed, one is epoxy, and one is cementitious.

Table 7. Commercial Encapsulant Products by Generic Chemical Type

Chemical Type	Number of Products
Acrylic latex	8
Acrylic copolymer latex (vinyl/acrylic/urethane)	1
Styrene-acrylic copolymer	1
Polyvinylidene fluoride copolymer latex	1
Polyvinyl acetate latex	1
Epoxy	1
Cementitious	1
Proprietary latexes	5

In 1997, ASTM subcommittee E06.23 published three standards for liquid lead-based paint encapsulants (preliminary standards were published in 1995). ASTM E 1795 (Standard Specification for Non-Reinforced Liquid Coating Encapsulation Products of Leaded Paint in Buildings) and ASTM E 1797 (Standard Specification for Reinforced Liquid Coating Encapsulation Products for Leaded Paint in Buildings) are the standards that specify performance criteria for encapsulants, while ASTM E 1796 (Standard Guide for Selection and Use of Liquid Coating Encapsulation Products for Leaded Paint in Buildings) was published as a selection guide. Of the 15 current encapsulant manufacturers, ten of them have chosen to have their products tested against the ASTM standards. Note that Dynacraft Industries, Inc., has chosen to test only one of its products. Table 8 lists the various encapsulation products and whether they have been tested against ASTM E 1795 or E 1797. All of the tested products met their respective ASTM standard(s).

Table 8. Testing of Encapsulation Products Against ASTM Standards

Encapsulant Manufacturer	Encapsulant Product(s)	ASTM Test Results	
		E 1795	E 1797
American Coatings Corporation	CC-2B	Not Tested	Not Tested
Coronado Paint Company	LEAD BLOCK™	Passed	Not Tested
Dumond Chemicals	LEAD STOP™	Passed	Not Tested
Dynacraft Industries, Inc.	Back To Nature Protect-A-Coat™ Back To Nature Exterior™	Passed Not Tested	Not Tested Not Tested
Encap Systems Corporation	EncapSeal™ I EncapSeal™ II	Passed Passed	Passed Passed
Fiberlock Technologies, Inc.	Child GUARD interior/exterior L-B-C® Type III	Passed Passed	Not Tested Not Tested
Fox Industries	FX-499	Not Tested	Not Tested
Global Encasement, Inc.	LeadLock™	Passed	Not Tested
Grace Construction Products	Lead Seal® Barrier Coat® II	Passed Passed	Not Tested Not Tested
Grayling Industries, Inc.	CONTROL Multi-Use Encapsulant	Not Tested	Not Tested
hallman/lindsay Quality Paints	WHITE POLYMER #500	Not Tested	Not Tested
Insl-x Products Corporation	INSL-CAP™	Passed	Not Tested
Proko Industries	SAF-T-SHIELD®	Not Tested	Not Tested
SAFE Encasement Systems	SE-120 Protective Skin	Passed	Passed
Specification Chemicals, Inc.	NU-WAL® #2500 Coating	Passed	Passed

4.0 STATE REGULATIONS

Twenty-four states were contacted in 2000 regarding their regulation of lead-based paint encapsulant products. The contacted states were: California, Colorado, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Maine, Maryland, Massachusetts, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, and Wisconsin. Certain states (e.g., Connecticut, Massachusetts, and Ohio) were chosen because manufacturers and past research indicated that these states actively regulate encapsulants. Other states were chosen because they are located in regions of the country (New England, Great Lakes, and South) where dense populations and older housing stock have resulted in a historically higher incidence of lead-based paint usage (EPA, 1995). Finally, California was contacted because of its history of environmental awareness and action.

Interviews with representatives from these states focused on whether the state currently has any regulations covering encapsulants and if they compiled lists of approved encapsulant products for use in their state. Of the 24 states contacted, eight states (Colorado, Connecticut, Maryland, Massachusetts, Michigan, New Hampshire, New York, and Ohio) compiled lists of approved, permitted, authorized, or acceptable encapsulant products. However, the requirements for inclusion on a state list are not the same for all states. Connecticut, Massachusetts, and Ohio require that the product pass the ASTM standards and be subjected to a toxicological assessment in order to be included on the state list. Massachusetts has an additional criterion that restricts encapsulant usage to interior surfaces. New York and Michigan require proof of approval from Connecticut, Massachusetts, and/or Ohio; Colorado requires that a product be approved in New York or Massachusetts; and New Hampshire requires that an encapsulant be approved by another state. Maryland has a different approach to its encapsulant regulations. It provides a list of encapsulants to select from, but in order to use any of these products in Maryland, the homeowner or contractor must first get approval from the Maryland Department of the Environment by passing a patch test (as described in Chapter 13 of the *HUD Guidelines*) of the selected product. It is worth noting that the Maryland list is not restricted to products that have passed ASTM standards. A summary of the current encapsulants and the states in which they are listed is shown in Table 9. Note that this table reflects updated lists that have been received from some of the states since the original interviews.

Compilation of encapsulant lists is only part of the regulatory process used by states to govern encapsulant use. Of the 24 states contacted, 22 responded that they do recognize encapsulant usage as an approved method of lead hazard control. Eleven of these states responded that they regulate encapsulant usage in some manner, while nine others indicated that they have no regulations of their own and instead refer users to HUD and/or EPA guidelines for advice on encapsulants usage. Of the remaining four states, Florida indicated that not only do they not regulate encapsulant usage in any way, but that they “don’t even regulate lead-based paint”; Illinois does not regulate or keep lists any longer; Rhode Island lists no criteria for use; and Vermont does not regulate encapsulants (the interviewed Department of Health representative stated that he has not seen encapsulant usage in Vermont since 1997 and that encapsulants were not considered to be cost-effective or to perform as well as other abatement procedures).

Table 9. Current Encapsulant Products and State Acceptance Listings¹

Encapsulant Manufacturer	Encapsulant Product(s)	On the State List of Accepted Encapsulants (date of last update)							
		CO (7/00)	CT ² (10/02)	MA (7/98)	MD (2/97)	MI ³ (6/01)	NH ² (11/00)	NY (2/01)	OH ³ (12/01)
American Coatings Corporation	CC-2B								
Coronado Paint Company	LEAD BLOCK™	√	√	√	√	√	√	√	√
Dumond Chemicals	LEAD STOP™	√		√		√			√
Dynacraft Industries, Inc.	Back to Nature Protect-A-Coat™ Back to Nature Exterior™	√		√	√ √	√	√	√	√
Encap Systems Corporation	EncapSeal™ I EncapSeal™ II	√ √			√ √	√ √	√ √	√ √	√ √
Fiberlock Technologies, Inc. ⁴	Child GUARD interior/exterior L-B-C® Type III	√ √	√ √	√ √	√	√ √	√ √	√ √	√ √
Fox Industries	FX-499				√				
Global Encasement, Inc.	LeadLock™	√	√	√	√	√	√	√	√
Grace Construction Products ⁵	Lead Seal® Barrier Coat® II	√ √			√ √	√	√ √	√ √	√
Grayling Industries, Inc.	CONTROL Multi-Use Encapsulant								
hallman/lindsay Quality Paints	WHITE POLYMER #500								
Insl-x Products Corp.	INSL-CAP™	√		√		√	√	√	√
Proko Industries	SAF-T-SHIELD®				√				
SAFE Encasement Systems	SE-120 Protective Skin	√	√	√		√		√	√
Specification Chemicals, Inc.	NU-WAL® #2500 Coating								

¹ Some states continue to list products that are no longer manufactured. These products are not shown in this table.

² Connecticut and New Hampshire also list Plaster in a Roll™ and Faster Plaster™ by FLEXi-WALL, which do not meet the ASTM definition of liquid encapsulant.

³ Michigan and Ohio have approved a product called "168-1 Lead Barrier Acrylic Membrane Coating" made by Coronado Paint Co. Coronado states that 168-1 is the internal designation for LEAD COVER™ and LEAD BLOCK™.

⁴ As of January 2000, Fiberlock is manufacturing only the two products listed. Previous products (e.g., L-B-C® Type I, L-B-C® Type II, and LeadMaster®) remain listed on some states and will continue to be available until inventory is depleted.

⁵ Grace Construction Products acquired IPC Corporation in March 2000. Some states still list IPC Corporation as the manufacturer of Lead Seal® and Barrier Coat® II, even though Grace Construction Products is the new manufacturer of these products.

5.0 DESIGN AND METHODS FOR USER SURVEYS

Two separate surveys were conducted to gauge the current usage patterns of lead-based paint encapsulants. The first survey was intended to characterize the experiences and opinions of major encapsulant users, while the intention of the second survey was to determine what types of information and recommendations concerning encapsulants are offered by lead hazard control professionals such as risk assessors and contractors. All survey interviews were conducted by Battelle staff via telephone. Visits to review records and to view encapsulated surfaces at five of the users' sites also were conducted by Battelle. This section describes the methods for identifying potential survey respondents and the actual administration of the surveys, as well as the criteria used to select the sites to be visited. As described in Section 5.5, Office of Management and Budget approval for conducting the surveys was obtained prior to conducting the interviews.

Encapsulant users were grouped into three categories (public housing agencies, military installations, and private individuals) for the purposes of the first survey, while all types of lead hazard control professionals were considered as one category in the second survey. Note that this entire study was designed as a reconnaissance effort as opposed to a series of formal, statistically-based surveys. As a result, the study did not include measurement, control, or characterization of inter-surveyor or inter-category variability. However, in order to maintain consistency during the interviews, the same Battelle staff member interviewed all respondents within a particular category.

Methods for identifying potential respondents to interview varied between categories, and were chosen based on their practicality for use in a reconnaissance effort. Attempts were made to obtain a wide variety of respondents (e.g., geographically representative, identified through different sources, etc.). Some degree of randomization was used to select users and professionals to interview from the identified potential respondents, however, not to the extent of a formal, statistically-based survey.

5.1 Identifying Public Housing Agencies

As a starting point to identify public housing agencies (PHAs) that previously used or are currently using lead-based paint encapsulants, an electronic message was distributed to all PHAs via the listserv that is maintained by the Washington, D.C.-based Public Housing Authorities Directors Association (PHADA). The text of this message indicated that Battelle would be conducting a survey for HUD, and requested that any PHA that had any experiences with encapsulants and would be willing to participate in a 15 to 30 minute interview to respond to either HUD or Battelle. Unfortunately, no responses were received from this request. The Council of Large Public Housing Authorities (CLPHA) in Washington, D.C., was then contacted about distributing a similar request to its members. CLPHA indicated that an electronic message probably would not be effective because very few of its members communicate via its listserv. As a result, the message was not distributed to CLPHA's membership (primarily a subset of PHADA's membership).

The lack of PHAs responding to the electronic communications and the fact that the reconnaissance-design of the study precluded making telephone calls to large numbers of PHAs to determine if they had ever used encapsulants necessitated an alternative method of identifying PHAs to interview. Thus, the second step was to review all of the encapsulant manufacturers' product literature that was obtained during the first phase of the study. Six of the former or current manufacturers listed some of their customers or included customer testimonials in their literature. Former manufacturers were considered along with the current manufacturers because the objectives of the survey were to interview users of various types of encapsulants and to identify older sites that possibly could be visited for further evaluation. The two former manufacturers were in business in the early 1990s; thus, sites that still have components encapsulated with these products were good candidates.

It is likely that the sites listed on the manufacturers' literature represent "best-case" applications of the manufacturers' products; however, many of the interview questions inquired about the process of selecting and using an encapsulant, and not just the performance of the encapsulant. In addition, PHAs were interviewed about all encapsulants that they had ever used and not just the encapsulant purchased from the manufacturer from whose literature their name was obtained. Finally, because of reasons such as employee turnover at the PHAs, these manufacturers' lists represented the best way available to identify PHAs that had applied encapsulants in the early 1990s.

In order to ensure geographical representation of the survey respondents, the PHAs were stratified by region of the country during the process of selecting PHAs to interview. Table 10 lists the 77 PHAs that were listed by the manufacturers (note that some PHAs were listed by multiple manufacturers), grouped by geographical region [defined as Northeast (NE), Southeast (SE), North Central (NC), South Central (SC), Northwest (NW), and Southwest (SW) for the purposes of this study]. Telephone numbers for these PHAs were obtained from HUD's PHA web page and by calling directory assistance in the respective cities.

Although the entire project was considered a reconnaissance information gathering effort and not a statistically-based study, an attempt was made to provide some degree of randomization to the process of selecting PHAs to interview. This was done by randomizing the order of the PHAs, stratified by region of the country, and then attempting to interview PHAs according to this order. However, only a fixed number of calls was made to each PHA to attempt an interview before moving on to the next PHA. Depending on the situation, 2 to 3 calls were made to a PHA and 2 to 3 days were given to a PHA to return a call after leaving a message. If no response was achieved, the next PHA was called. This process continued until the targeted number of interviews was reached within each region (6 apiece in NE, SE, NC; and 2 apiece in SC, NW, SW).

During the interview process both New York City and Marin County (California) indicated that they were aware of another PHA (Tampa, Florida; and San Francisco, California; respectively) that had used encapsulants and likely would participate in an interview. Because it was felt that communications among these PHAs might mention the on-going encapsulant survey, calls also were made to these identified PHAs, temporarily overriding the randomization order that had been defined.

Table 10. PHAs Listed in Encapsulant Manufacturers' Product Literature

Northeast (NE)	Southeast (SE)		North central (NC)
Albany, NY Cambridge, MA Chelsea, MA Cumberland, PA Falls Church, PA Harrisburg, PA New York, NY Philadelphia, PA Pittsburgh, PA Pottstown, PA Reading, PA Taneytown, MD Troy, NY	Ashville, NC Bainbridge, GA Blacksburg, SC Brunswick, GA Chattanooga, TN Clover, SC Columbus, GA Daytona Beach, FL Doerun, GA Douglas, GA Durham, NC Gastonia, NC Goldsboro, NC Greensboro, NC Honea Path, SC Key West, FL Kingsport, TN Kinston, NC Knoxville, TN	Laurens, SC Lexington, SC Mayfield, KY Memphis, TN Morristown, TN Orlando, FL Richmond, VA Rockingham, NC Rocky Mount, NC Sanford, FL Scottsboro, AL Sonoma, GA St. Petersburg, FL Swainsboro, GA Tarboro, GA Tifton, GA Whiteville, SC Wilmington, NC	Chicago, IL Cleveland, OH Gary, IN Grand Island, NE Grand Rapids, MI Kokomo, IN Milwaukee, WI Oakcreek, WI Rockford, IL Romulus, MI St. Paul, MN Superior, WI Terre Haute, IN Toledo, OH
South central (SC)	Northwest (NW)		Southwest (SW)
El Paso, TX Hattiesburg, MS Helena, AR New Orleans, LA St. Claire, MO St. Louis, MO	None		Alameda County, CA Denver, CO Los Angeles County, CA Marin County, CA Oakland, CA Phoenix, AR Ventura County, CA

Finally, because no PHAs were identified in the Northwest by any of the methods described above, “cold calls” were made to selected PHAs in this region of the country. Using HUD’s web site, PHAs were selected from those cities in the Northwest that have lead poisoning prevention programs.

5.2 Identifying Military Installations

For the interviews of personnel at military installations, previous work indicated that the U.S. Department of Defense’s Interagency Lead-Based Paint Task Force would be a good source that could identify military installations throughout the country that have previously used or are currently using encapsulants. However, it was determined that this task force has disbanded. During the process of trying to get in touch with the task force, contact was made with the U.S. Army’s Construction Engineering Research Laboratory (CERL). CERL maintains an open contract that Army installations can use to perform encapsulant work and was able to identify eleven installations that recently have applied or are planning to apply encapsulants. Table 11 lists these installations along with a few other U.S. Army, U.S. Navy, and U.S. Air Force

installations that, based on Battelle's or HUD's knowledge, may have lead-based paint issues to address.

Table 11. Military Installations Identified by CERL or through Battelle/HUD's Previous Work

Northeast (NE)	Southeast (SE)	North central (NC)
AP Hill, MD Carlisle Barracks, PA Fort Dix, NJ Fort Drum, NY Fort Meade, MD Fort Monmouth, NJ Indian Head Naval Station, MD	Elgin Air Force Base, FL Fort Bragg, NC Fort Knox, KY	None
South central (SC)	Northwest (NW)	Southwest (SW)
Brooks Air Force Base, TX Fort Bliss, TX Fort Sam Houston, TX Tinker Air Force Base, OK	Fort Lawton, WA	Fort Irwin, CA Hill Air Force Base, UT Kirtland Air Force Base, NM Presidio of Monterey, CA

Following the same procedures as were used for the PHA interviews, the military installations were randomized within region of the country to determine the calling order, and then calls were attempted in the manner described above. In order to fill in the gaps in the table, efforts were made during the interviews with these military installations to inquire if they could suggest other installations that might be interviewed. In addition, "cold calls" were made to military installations in regions of the country where the targeted number of interviews (3 apiece in NE, SE, NC; and 1 apiece in SC, NW, SW) still remained incomplete.

5.3 Identifying Private Users

Private users proved to be the most difficult of the three categories of encapsulant users to identify. It had been hoped that private users might be identified through contacts with neighborhood renovation or historic preservation groups and through encapsulant manufacturer product literature and/or listings of training participants. However, no private users were listed in any of the encapsulant product literature, and no attempts were made to request lists of training participants because it was felt that the manufacturers that conducted such training probably sold products that would not be appropriate for do-it-yourself users.

Encapsulants have not been conveniently available to the do-it-yourself market. In the last five years, information about encapsulant products has been available on the Internet and as of early 1999, at least two products have been available through "big box" home improvement retail stores. Before this, most private homeowners would have needed to have lead encapsulant products purchased and applied by a qualified lead contractor or consultant. Therefore, contractors and consultants qualified to participate in lead-based paint abatement activities were identified as a possible aid in identifying private users. However, the issue of customer privacy in addition to the undue burden it would place on consultants to search their records for private users made this option impractical.

Attempts were made to identify and contact neighborhood groups in various cities; however, this too yielded no names of private users to interview. The only method that proved to be fruitful was talking with three community redevelopment authorities that were identified through contacts made during the survey of PHAs. These redevelopment authorities (Savannah, Georgia; Richmond, Virginia; and Carlisle, Pennsylvania) have programs in which housing is sold to private users after it is renovated (sometimes using encapsulants). The only one that led to any specific private users was Savannah, which was extremely helpful (even going door-to-door to leave door handle flyers in one particular neighborhood) and was able to identify six homeowners that were willing to be interviewed for the survey.

Because of the limited success with these sources, additional methods were attempted, including browsing Internet “chat” rooms associated with national television programs about home renovation [e.g., programming on HGTV (Home and Garden Television), *This Old House*] and distributing Battelle-wide messages inquiring if any staff members have ever used encapsulants. No additional private users were identified via these methods, although responses from two Battelle staff members led to two contractors that were interviewed in the survey of other lead hazard control professionals.

5.4 Identifying Other Lead Hazard Control Professionals

The primary source of potential respondents for the survey of other lead hazard control professionals was www.leadlisting.org, a HUD-sponsored web site that lists risk assessors and lead inspectors throughout the country. Names of professionals in various states were randomly selected from this list to be interviewed. In addition, other names were added to the list of people to be called, including contractors mentioned during interviews with major users, representatives from the redevelopment authorities identified during the search for private users, specific contacts provided by HUD, members of the ASTM Task Group E06.23.30 on Encapsulation of Lead Paint, personal contacts of Battelle staff, and the two contractors identified through the Battelle-wide communication mentioned above.

5.5 Survey Administration

Interview questions for the different surveys were intended to identify reasons for selecting encapsulants, perceived quality of information available to aid decision-making, and experiences with encapsulant application and performance. Answers did not require respondents to reference records or files. Respondents were allowed to provide “best guesses” for questions that asked for specific numbers or percentages (e.g., the number of times a user has applied encapsulants) if they did not readily know exact figures. Tables B-1 and B-2 in Appendix B contain the scripts for the “Survey for Major Encapsulant Users” and the “Survey for Other Lead Hazard Control Professionals” that were used during the telephone interviews. These scripts provided a basis for the information to be collected in the interviews, which were conducted as informal conversations or discussions rather than formal interviews. Additional insights were sometimes gained from the open-ended discussions generated by the original questions.

Per the Paperwork Reduction Act (44 U.S.C. Chapter 35), Office of Management and Budget (OMB) approval was obtained prior to conducting the interviews. Federal Register notices of the proposed information collection (64 FR 27593, 65 FR 7393) were published on May 20, 1999, and February 14, 2000. Approval from OMB was received on March 8, 2000. The OMB approval number is 2539-0016, and the approval expires March 31, 2003. All interviews were conducted by Battelle representatives between September 2000 and March 2001.

5.6 Site Visits

One of the questions that was asked of encapsulant users was if they had any applications of encapsulants that could be viewed by Battelle staff. At least 17 different users responded positively to this question (6 additional users stated that they would check into it if requested, but follow-up with these users was not done because there were sufficient other users willing to host the site visits). From those users that indicated that they had application sites that could be visited, five were selected for site visits. These five sites were selected based on a variety of factors including: age of encapsulant, encapsulant product used, components encapsulated, and geographic region.

The five sites selected for visits were PHAs in Knoxville, Tennessee; Philadelphia, Pennsylvania; and Milwaukee, Wisconsin; an Army installation near Carlisle, Pennsylvania; and a county rehabilitation authority in Carlisle, Pennsylvania. All visits were scheduled as half-day visits in which Battelle staff interviewed site representatives to verify information collected during the telephone interviews, reviewed any encapsulant monitoring or maintenance records that were kept by the site, and visually evaluated the actual encapsulant applications. Site representatives were told that no destructive tests would be conducted; however, permission was asked to take photographs of the encapsulants at each site. Site visits were conducted between January and March 2001.

6.0 USER SURVEY RESULTS

Results from the user surveys are discussed and summarized in this section. In order to protect the confidentiality of the respondents, specific comments are not associated with any respondents in this report. Tables A-2, A-3, and A-4 in Appendix A list the contact information for those respondents that participated in the user surveys. Tables containing respondents' answers to some of the key questions are provided in Appendix C (respondents are identified by assigned codes instead of names).

6.1 Public Housing Agency Interviews

PHAs were contacted to determine the usage of encapsulant products on lead-based paint in public housing. As previously mentioned, most PHAs contacted were chosen because they were identified in encapsulant manufacturers' product literature as having used an encapsulant product in the past. Additional cities were contacted to add information from geographic areas not fully represented in the product literature.

Personnel with the most knowledge about encapsulant usage at the PHAs proved to be the maintenance and painting supervisors. These personnel had the most direct experience with the application and performance of any encapsulants used by the PHA. Whenever possible, interviews were conducted with these individuals.

Forty-seven PHAs were interviewed for this report. The breakdown by region is shown in Table 12, along with the originally intended distribution of respondents. More interviews than planned were ultimately completed because of the fact that additional PHAs were called if PHAs did not return calls within a few days after messages were left with them concerning the survey (see Section 5.1). In the end, many PHAs returned the calls a couple of weeks after the original messages were left. Interviews still were conducted with these PHAs even if the targeted number of completed interviews had already been completed within their regions. PHAs in the Northwest were "cold-called" until some were found that have used encapsulants.

Table 12. Distribution of Completed PHA Interviews by Region

	NE	SE	NC	SC	NW	SW
Targeted Number of Interviews	6	6	6	2	2	2
Actual Number of Interviews	8	8	12	4	11	4

Of these 47 PHAs, 23 reported using encapsulants either in the past or currently, 22 reported that they did not use encapsulants, one did not know if there had been past encapsulant use or not, and one had not used encapsulants in the past but had recently specified an encapsulant product for an upcoming project. This breakdown is shown in Table 13. Note that even though most of these PHAs (except for those in the Northwest) had been identified as encapsulant users in the product literature, some denied having used encapsulants when interviewed. This can be explained by possible inaccuracies in the manufacturers' product literature or a lack of monitoring and knowledge of past encapsulant use by interviewed PHA

personnel who were not employed by the PHA at the time the encapsulants were applied (at least seven respondents mentioned that they were relatively new to the job).

Table 13. Reported Use of Encapsulants by PHAs

	NE	SE	NC	SC	NW	SW
Use Encapsulants	5	7	5	2	1	3
Do Not Use Encapsulants	3	1	6	2	9	1
Other	0	0	1	0	1	0

The PHAs chose to use encapsulants for various reasons. The most common reason was that lead consultants recommended their use on various projects. Some of the other reasons given are listed below:

- Housing contained historical components that could not be removed from the unit;
- Projects had areas from which the paint could not be removed from the component;
- Removal of paint and/or components was not cost-effective.

The time periods over which encapsulants were used among interviewed PHAs ranged from applications 15 years in the past to recent and on-going applications. Surfaces on which the encapsulants were applied included soffits and fascia, walls, ceilings, closet shelves and cleats, porch poles, hand rails, exterior siding, wood doors and windows, stair risers, baseboards, and radiators.

Of the 23 PHAs that have reported using encapsulants, 18 were satisfied with how the product was holding up, one had a problem with the performance because children in the development could remove the product from the applied surface, and four did not know how the product was holding up because they were not actively monitoring the encapsulated surfaces. Thirteen of them reported that they would use encapsulant products again, while four stated that they would not use encapsulants again and six said that they might if needed or if recommended.

Encapsulant products were selected for use through various avenues. Many PHAs selected products based on recommendations of lead consultants or contractors, highlighting the importance that consultants play in recommending abatement strategies. Some PHAs took the initiative and researched products, attended lead or housing conferences where encapsulant manufacturers were present, or found manufacturers and products through HUD contacts.

In discussions with the PHAs, there seemed to be some confusion between what was considered an “encapsulant” and what was considered an “enclosure.” When the PHA contacts were asked if they used any encapsulant products, several of them proceeded to describe enclosures that had been mechanically installed over lead-based paint on surfaces or components. This confusion was less prevalent in the northeast and southeast where the PHAs in general had a greater knowledge of a wider variety of encapsulant products and other lead hazard control techniques.

A number of PHAs indicated that they used products other than encapsulants as a control for chipping and peeling on surfaces containing lead-based paint. Paint products utilized as a control included a rubberized paint, a paint booster formulated to reduce paint peeling caused by water and moisture, and regular latex paint. The latex paint user indicated that clearance testing still is performed after the paint application, as well as annual and semi-annual monitoring of the painted surfaces. That contact was aware of encapsulant products, but did not use them because he did not believe they wore any better than regular paint and they cost twice as much. The user of the paint booster was not aware of encapsulant products on the market or how to contact manufacturers or acquire encapsulant products. The contact indicated that he had a limited budget to research suitable products and asked how to go about finding lists of encapsulant products.

Most of the PHAs that used encapsulant products said they had referred to the *HUD Guidelines* when making their decision, or they assumed their lead consultant or contractor had done so for them. One PHA contact continued to say, however, that he decided against using encapsulants because HUD seemed to keep changing its mind, and he did not want to use an encapsulant product and then have to remove it later if HUD decided that encapsulants were not performing to expectations.

Because many of the PHAs contracted out the encapsulant application, they did not perform the patch test described in the *HUD Guidelines* themselves. However, a number of them had seen it performed. Contacts in some of the eastern states with more strict lead regulations had more experience with and a stronger opinion of the patch test. One contact indicated that he thought the patch test was lengthy and destructive. To encapsulate a wall and then harm it to test it seemed counter-productive to him. Another contact said that representatives from a state agency performed the patch test after application as part of a clearance test. The contact said that it was not worth encapsulating only to fail the test due to poor product performance or a lack of uniformity in product application to the surface. Therefore, they chose to remove all lead-based paint.

Although the question was not asked directly, it did not appear from the conversations with PHA representatives that they were following the monitoring schedule laid out in Chapters 6 and 13 of the *HUD Guidelines* (one and six months after application and then every 6 months to 4 years, depending on the circumstance). Many of the PHAs have checked to see how their encapsulants are holding up, but this monitoring has been according to their normal maintenance and upkeep practices and has not necessarily followed the suggestions in the *HUD Guidelines*.

Based on the interviews conducted, there appeared to be a noticeable difference in encapsulant usage between the eastern and western portions of the United States. In general, the eastern half of the country has a higher prevalence of older housing with lead-based paint, a longer history of encapsulant usage, and more state laws that may stimulate usage. As a result, PHAs in the eastern states have more experience and familiarity with encapsulant products. In contrast, the western U.S. has a lower prevalence of dwellings with lead-based paint and fewer state regulations governing encapsulants. This apparently has led to PHAs in the western states having less familiarity in the use of encapsulant products and less knowledge of the encapsulant market.

6.2 Military Installation Interviews

Personnel at 14 military installations were interviewed in this survey. The installations were selected to give geographical representation as much as possible. However, distribution of installations is not uniform across the lower 48 states. The final group included nine Army installations, four Air Force installations, and one Navy installation (Table 14).

Table 14. Distribution of Completed Military Installation Interviews by Region

	NE	SE	NC	SC	NW	SW
Targeted Number of Interviews	3	3	3	1	1	1
Actual Number of Interviews	3	3	1	3	2	2
Air Force	0	1	1	1	1	0
Army	2	2	0	2	1	2
Navy	1	0	0	0	0	0

The best information about encapsulant usage on military installations was obtained from their environmental engineering groups. In general, respondents reported that component removal was used for abatement of lead-based paint whenever possible for residential units. Much military housing, especially Army housing, was built before 1978. However, respondents stated that routine military maintenance practices give regular attention to the condition of both exterior and interior paint. Peeling or defective paint is repaired as needed. Residential units have been inspected for the presence of lead-based paint and abated where needed.

Lead-based paint has been identified on all but one of the military installations that participated in this survey. In general, older military housing has both exterior and interior lead-based paints. According to the military representatives interviewed, housing built in the late 1950s had lead-based paint in specific exterior areas only (e.g., porch posts and carport supports), while interior surfaces in these units did not have lead-based paint.

Military installations usually have written, long-term plans for buildings and other facilities. Many older housing units are being renovated, demolished, or privatized by the military according to planned schedules covering one to ten years into the future. Encapsulant coatings have been applied to components of some of these units to allow safe housing until the units are taken out of service. Conversely, interiors of units that are to be maintained as residential units usually undergo component removal to become lead-free. This is true even of historical housing units.

Some military installations have historical housing and other buildings where component removal is not possible either because of requirements for historic preservation or the need to retain historic detailing that would not be cost-effective to replace. A number of respondents in this survey had used encapsulant products on historic units, especially on exteriors. Substrates encapsulated include historic brick, cut stone, wood siding, architectural details, porch posts, and railings.

The Army has been actively encapsulating lead-based paint on a number of installations under the guidance of the Army Corps of Engineers Construction Engineering Research Laboratory (CERL), which has a Lead-based Paint Hazard Control Technology Team tasked with “Cost Effective Technologies to Remove, Characterize, and Dispose or Reuse Sources of Lead Hazards.” These installations have been scheduled for encapsulation of lead-based paint through a CERL contract.

In contrast, the few Air Force installations participating in this survey were less supportive of the use of encapsulant products to abate lead-based paint, and did not indicate that there is a system-wide plan to address lead hazards (i.e., each installation makes independent decisions). Based on this very limited group, component removal is the first choice, followed by painting with good quality paint. Only one respondent was willing to consider using an encapsulant product in the future.

As shown in Table 15, military respondents provided mixed responses concerning possible future use of encapsulants. Many of the Army respondents plan to use encapsulants again. Two users said they would not use encapsulants in the future; although these installations are on the CERL list and funded for upcoming encapsulant work. Among the Air Force respondents interviewed, there was a strong feeling that component removal was the best approach and that encapsulants did not have advantages over high quality paints in serving as a barrier to lead-based paint. The lone Navy respondent preferred component removal but will be forced to use encapsulants on historical housing units due to local historic preservation regulations.

Table 15. Reported Use of Encapsulants by Military Installations

	Air Force	Army	Navy
Has lead-based paint identified in housing units?	Yes = 3 No = 1	Yes = 9	Yes = 1
Has there been past use of lead encapsulant coatings in housing units?	No = 4	Yes = 5 No = 2 Other = 2 ^a	Yes = 1
Do you expect any future use of lead encapsulant coatings in housing units?	Yes = 1 No = 3	Yes = 6 No = 1 Other = 2 ^b	Yes = 1

^a “Encapsulate” lead-based paint with high quality paint.

^b May use in future, if convinced of advantages over high quality paint.

While respondents knew that HUD had guidelines for handling lead-based paint in residential housing, only two said that they had consulted the *HUD Guidelines* when making a decision about using an encapsulant. The Army participants relied on Army guidelines [e.g., Hazardous Asbestos and Lead Optimal (HALO) Management program, www.ccer.army.mil/painter1/halo.html] for decision making. The Air Force participants preferred component removal. In terms of risk assessment and paint assessment, all respondents were familiar with national standards for lead-based paint and reported the use of trained

personnel or private contractors for these activities in residential units and other structures where children might be present.

6.3 Private User Interviews

Private users of encapsulants were not as easily identified as anticipated. There was no direct method for determining who had used encapsulant products in their own homes. The manufacturers did not identify private homeowners in their product literature as they had the various PHAs. Some home improvement stores sell some encapsulant products, but there is no way of identifying past users to interview them and determine their opinions on the product performance.

An attempt was made to identify private users who had utilized encapsulants when renovating historical housing. Calls to historical districts and neighborhood organizations indicated that while many historical and neighborhood organizations recommended the use of encapsulants to cover lead-based paint in order to preserve the historical nature and retain the original components of the housing, the organizations kept no lists of those who had used the encapsulant products. As a result, no private homeowners were identified through these sources. The few private homeowners identified were discovered through conversations with community redevelopment authorities, which manage the refurbishing of private homes that are subsequently sold to private homeowners. The renovation and remodeling activities in these older homes sometimes includes the use of encapsulant products to reduce the lead hazards.

All of the identified private homes were located in the eastern half of the U.S. In these houses, encapsulants were applied to such surfaces as window sills and casings, doors, door frames, trim, mantels, porch columns, and exterior siding. The agencies that applied the encapsulants reported having mixed results with their performance. Some said that the encapsulant products looked good and had held up well, while others revealed that they were having to replace or remove the encapsulant product due to poor performance. Even with the mixed performance, all the agencies that had used encapsulants in private housing indicated that they would continue to use encapsulants in the future.

Only two of the private homeowners were available to be interviewed. In these cases, the respondents stated that the encapsulated surfaces still appeared to be in good shape. It was evident from the conversations, though, that the respondents did not have much knowledge about the encapsulation products that were used in their homes.

6.4 Other Lead Hazard Control Professional Interviews

In addition to manufacturers and encapsulant users, interviews were conducted with lead-hazard control professionals experienced in the use of encapsulants. The interviews were intended to assess opinions on encapsulants as an abatement choice and to determine whether enough information was available for educated decisions on recommending encapsulants. Respondents included trainers, contractors, risk assessors, scientists, engineers, and other professionals in the lead abatement field (Table 16). Their professional background included private practice, commercial business, military, and government. Some of these professionals have participated in ASTM standards development activities for lead-based paint encapsulants or are a part of major organizations within the lead community. Experience levels in the lead-based paint abatement arena ranged from more than 20 years to as little as 2 years.

Table 16. Job Descriptions of Interviewed Lead Hazard Control Professionals

	Non-Military	Military
Abatement Consultant	2	0
Abatement Contractor	3	0
Architect	1	0
Industrial Hygienist	0	1
Risk Assessor / Inspector	7	0
Scientist / Engineer	1	2
Trainer	1	0
Miscellaneous	4	0

A total of 22 professionals completed the interviews. Table 17 shows the final number of respondents per geographic region compared to the targeted number.

Table 17. Distribution of Completed Lead Hazard Control Professional Interviews by Region

	NE	SE	NC	SC	NW	SW
Targeted Number of Interviews	4	4	4	4	4	4
Actual Number of Interviews	5	4	6	2	2	3

Seventeen of the 22 interviewed professionals reported that they provide information to their clients on encapsulation as a tool for reducing lead-based paint hazards. These respondents provide information on encapsulants as one option for abating lead-based paint, especially on historic structures where component removal is not possible. Exterior siding, historic brick, and architectural details often need to be abated in place. Three of the respondents that do not provide information on encapsulants stated that they were not convinced that encapsulant products were any more effective as lead barriers than high-quality paint.

The response of the interviewed professionals to the question of whether they refer clients to Chapter 13 of the *HUD Guidelines* must be interpreted in light of the respondents'

perceived role with their clients, as well as their perceived need to use and understand the *HUD Guidelines*. While only three respondents refer clients to Chapter 13 of the *HUD Guidelines* for advice on the proper use of encapsulants, the majority of respondents reported that their clients were paying for their professional expertise, thus, it was their job, not their clients' job, to understand the *HUD Guidelines*. Moreover, in a few cases, the typical client was another lead hazard professional (contractor, etc.) who would already have consulted the *HUD Guidelines* and planned an appropriate project. One respondent stated that "clients are not referred to the *HUD Guidelines* because they (*HUD Guidelines*) are always way behind the best practices, and better information is available from lead abatement contractors who do this work daily." In the case of military respondents, the previously discussed ASTM standards and Army guidelines were the guidance documents more commonly suggested as references.

Almost all of the respondents reported having the needed information about the selection and use of encapsulants. Some of this information came from training courses, trade shows, manufacturers' literature, standards, and guidelines. However, the respondents in this survey reported recommending encapsulation in only a small percentage of abatement jobs. It was difficult to get the respondents to provide a definitive number, except for the eight who never recommend the use of lead encapsulant products. One used an encapsulant product only once, and the decision was made for him. As the responses listed below reveal, many of the respondents who recommend encapsulants had a qualifier to add.

- Used one time only
- Only for flat surfaces such as exterior walls if component removal is not possible
- Only when components cannot be removed
- Only when component removal is not cost-effective
- For historic preservation when component removal is not possible
- Almost always when unit is scheduled for demolition or complete renovation within 10 years
- Over half the time because it is cost-effective, especially for flat surfaces such as walls and ceilings

The respondents mainly viewed their role as meeting the information needs of their clients. The types of information requested by clients included:

- What are the options in terms of types of encapsulants available in the geographical area?
- How can a trained contractor be identified and how should a product be specified?
- How can solid information about encapsulants be separated from marketing and possibly exaggerated claims?
- Various technical questions about coating failures, performance of encapsulants, and effectiveness of lead abatement using encapsulants

Respondents' experiences with or perceptions of the effectiveness of encapsulation range from "high quality paint is as effective as specially formulated encapsulant coatings" to

“perception of effectiveness is not as important a consideration as identifying a cost-effective option for lead abatement.” Some specific responses are listed below:

- Encapsulants are perceived as weather-sensitive, but some types may be better than others.
- Perception is really not important. Want legal, cost-effective remedy.
- State authorities are not always proponents of encapsulant use, which is confusing to homeowners because national authorities consider encapsulants a viable option for lead-safe houses.
- Encapsulants are no more effective at encapsulating lead-based paint than a high-quality paint. An intact paint surface is safe.
- Encapsulant use around doorways and in areas subject to impact from traffic or toys may not be a good option.
- Properly applied encapsulant can be a cost-effective path to lead-safe housing.
- Very effective on non-friction surfaces.
- Good; easy to apply; good appearance.
- Probably effective, but still too expensive.
- Not effective for this climate; formulations optimized for Northeast states.
- Planning own research to address effectiveness of lead encapsulant coatings.

There is some agreement that a time-saving and cost-effective method of abating lead-based paint is needed, especially in the private sector. Some respondents do not feel cost alone will be enough to drive increased use of encapsulants until regulations for abating lead are enforced in the private sector, especially in the Western and Southern states. The military responses favored component removal except where components could not be removed.

7.0 SITE VISITS

Site visits were conducted for the purposes of evaluating what data might be available in the field should HUD decide to conduct a long-term study of encapsulant performance. Using the criteria discussed in Section 6.6, five sites were selected for evaluation:

- Public Housing Authority in Knoxville, Tennessee
- Public Housing Authority in Milwaukee, Wisconsin
- Public Housing Authority in Philadelphia, Pennsylvania
- Army Barracks near Carlisle, Pennsylvania
- Redevelopment Authority of Cumberland County in Carlisle, Pennsylvania.

Figures 1 to 5 show typical buildings at each of these sites, respectively.



Figure 1. Lonsdale Project, Knoxville, Tennessee



Figure 2. Parklawn Project, Milwaukee, Wisconsin



Figure 3. Liddonfield Project, Philadelphia, Pennsylvania



Figure 4. Carlisle Barracks, Pennsylvania



Figure 5. Pitt Street, Cumberland County, Pennsylvania

7.1 Overview of Selected Sites

A number of substrates including wood, metal, brick, cut stone, plaster, and concrete had been encapsulated at these five sites. Coatings had been in place from 15 years to seven months, and some had been overcoated for maintenance or decorative purposes. Table 18 summarizes the various characteristics of each of the sites.

Table 18. Characteristics of Sites Visited in Study

	Year Buildings Constructed	Year Encapsulant s Applied	Substrates/Components Encapsulated
Knoxville	1939, 1952	1988 - 1989	Interior metal stair risers, Exterior metal porch posts
Milwaukee	1936	1985 - 1987	Interior plaster walls Interior concrete ceilings
Philadelphia	1950s	1993 – 2001	Interior concrete walls, Interior wood baseboards, Interior concrete ceilings
Carlisle	1800s	1999 - 2000	Exterior wood walls. Exterior brick walls, Exterior cut stone trim, Exterior wood porch posts
Cumberland	1800s	1998	Exterior brick walls, Exterior wood windows, Exterior wood door frames

General details about each site visit are described below, including comments on the possibility of using the sites in a long-term evaluation study of encapsulants. A discussion of the performance of all the evaluated encapsulants is provided later in the section.

- When tested and treated in the late 1980s, only two public housing projects in Knoxville were found to have lead-based paint, and the only components affected were interior stair risers, exterior porch posts, exterior door frames, and an occasional decorative wood rack installed by tenants. All windows had previously been replaced during another redevelopment project. No lead-based paint was found on these replacement windows. The door frames and wood racks were removed, while the stair risers and porch posts were encapsulated. Current plans are to remove the porch posts as part of a new renovation effort. The site visit was conducted on January 23, 2001. Two vacant units at each of the two housing projects (Lonsdale and Western) were evaluated. Because of the plans to remove the porch posts, Knoxville would not be a likely candidate for any long-term study of encapsulants.
- In 1985, Milwaukee's PHA became one of the first PHAs in the country to extensively use encapsulants. All interior walls and ceilings in over 550 units in the Parklawn housing project were treated. In addition, all windows were replaced and all door frames were enclosed with metal to eliminate the lead hazards on these

surfaces. Annual inspections are performed in each unit, and damaged surfaces are re-encapsulated or re-enclosed as necessary. The site visit was conducted on March 14, 2001. Six vacant units scattered across the east and west portions of Parklawn were evaluated. Milwaukee could be a candidate for a long-term study of encapsulants; however, its superb attention paid to repair and maintenance needs might make this site significantly different than other PHA sites across the country.

- Philadelphia's PHA has used encapsulants extensively over the past 7 to 8 years. Fifty-eight separate projects are managed by the PHA. All units in projects known to have lead-based paint have encapsulants re-applied between tenants. Over the years, Philadelphia has tried various encapsulants. Reasons ranging from problems with adhesion to workers complaining of skin rashes (note that there is no way to verify if the encapsulant or something else was responsible for the rashes) caused Philadelphia to stop using all products except one. All interior surfaces are treated during the between-tenant applications. In an effort to reduce costs, current plans are to begin using a regular paint to cover undamaged encapsulated surfaces. Damaged surfaces will be repaired and re-treated with the encapsulant. The site visit was conducted on February 8, 2001. Four vacant units at the Liddonfield housing project were evaluated. Because treated units number in the thousands, Philadelphia would be a possible site should a long-term study of encapsulants ever be conducted. However, one potential constraint would be that an encapsulant film might never get to more than 7 to 8 years of age before new encapsulant is applied over it, and in reality, many of them would never get to be that old because the average turnover rate in the units is a lot more frequent.
- The Carlisle Army Barracks has found lead-based paint on exterior building walls, porch posts, windows, and door frames. Because of the historical nature of the buildings, encapsulation was chosen as a way to preserve the exterior walls and porches. A separate program was used to replace the windows and door frames. A contract to perform the encapsulation was put out for bid, based on the specifications in the CERL contract (see Section 6.2). The winning contractor applied the encapsulant on four buildings in the summer of 2000. Additional buildings are planned for encapsulation in the next couple of years. The site visit was conducted on February 7, 2001. All four encapsulated buildings were evaluated. There is little chance that these buildings will be demolished any time in the near future. Thus, if the goals of a long-term study were to monitor and evaluate the performance of newly applied encapsulants for an extended period of time, Carlisle (and other similar Army facilities) would be a good site to include in the study.
- The Redevelopment Authority of Cumberland County, Pennsylvania, runs a program to rehabilitate housing, especially in the city's historic district, and offer it for sale to lower income private homeowners. Four different houses on one city block (Pitt Street) have been encapsulated over the last two years. Two different generations of one encapsulant were used on the exterior of these houses. The site visit was conducted on February 7, 2001. All four encapsulated buildings were evaluated. The lack of control over what is done to these buildings in the future (due to the fact that

private individuals now own them) means that buildings treated under this program would not be likely candidates for any long-term study of encapsulants.

7.2 Site Visit Results

The site visits were composed of two primary activities: (1) conducting an interview to collect some additional information about the use of encapsulants at the site, and (2) examining the actual encapsulant applications. Data collection forms that were used for both of these activities are provided in Appendix D.

One item that stood out based on the site visits is that record-keeping on encapsulant usage and any on-going monitoring or maintenance is fairly limited. Paperwork such as work orders for overall maintenance upkeep may exist in storage, but is not readily available; nor are separate files usually maintained on encapsulation details (e.g., exactly which components were treated in which units). Note that this practice of filing records is not necessarily unexpected, as the purpose of the files likely would be for documenting building maintenance, not research studies.

Investigation of the in-field durability of lead encapsulant coatings was limited to visual inspection of substrates at the sites visited. No field tests were conducted. In addition to on-site examination, encapsulated surfaces were photographed.

The site visit team looked for loss of adhesion (peeling), cracking, water damage, stain/color variation, chalking (exteriors only), friction and impact damage, rust, and deteriorated substrates. At one site where units were being demolished and a second site where a car had crashed through the back wall of a unit, paint chips from damaged areas were collected and examined.

Overall, the encapsulants that had been applied at the sites were in excellent shape. Instances in which the encapsulants were damaged were uncommon, and usually there was a good explanation for these cases. The performance of encapsulants on various surfaces is discussed below.

Interior stair frames

Lead-based paint was detected on steel stair risers by the Knoxville PHA. The steel stair frames installed as a structural part of units built in 1939 and 1952 could not be removed, so the decision was made in 1988 to encapsulate the lead-based paint. The reinforced two-part encapsulant has been overcoated with paint through the years to maintain a good appearance.

Figure 6 shows the brown painted stair risers. This staircase, which was in a unit being remodeled between tenants, had seen heavy resident use and the coating layers were intact. Paint and encapsulant adhesion was good.

In Figure 7, gray encapsulant can be seen on the step edges where the paint is worn away. This unit was being totally renovated. Abrasion from construction debris tossed down the stairs

and shoveled into trucks had worn away the brown overcoat, but the gray encapsulant layer in place for 12 years was mainly intact.

Interior walls and ceilings

The Philadelphia PHA has continuously used encapsulant coatings in housing units since the 1993 to 1994 time period. The units have concrete walls and ceilings with some interior wallboard. Beige-tinted encapsulant was applied to all flat surfaces, including woodwork. No overcoat was used.

Overall, the interior walls of the units visited were intact with relatively good gloss and appearance, although the units were empty for extensive remodeling. Areas around light switches where heavy wear might occur were intact. There was minor impact damage (chipping) in some areas from picture nails, gouges in some walls, and limited chipping on exposed corners at the metal beading as shown in Figure 8. Surfaces on narrow stairwell walls were intact. Figure 9 shows another wall with intact encapsulant, except for minor damage around the outlet caused by renovation workers. The PHA has been so satisfied with the appearance and the durability of the encapsulant coating that they typically re-coat remodeled units with encapsulant instead of paint.

On upstairs walls of one unit there were areas of peeling and cracking. The cracking shown in Figure 10 appeared to be caused by moisture coming through the wall. A slightly darkened stain was visible. Workers confirmed that there had been a roof leak in that area. The damaged area was confined to a section of wall about 3 feet wide by 4 feet high beginning at the ceiling and extending downward. As seen in Figure 11, the beige encapsulant coating was peeling away from the underlying paint in a spot behind the bedroom door.

An encapsulant with fiberglass mat had been applied to walls and ceilings in Milwaukee Parklawn in 1985. Figures 12 and 13 show intact walls. The encapsulant was in excellent condition in all six units that were inspected. In Figure 14, some minor damage can be seen on a corner in a high traffic area. In addition, a small area of peeling (approximately 1" x 2") was observed near the baseboard in one unit. It appeared that this may have been caused by maintenance workers replacing the baseboard. Milwaukee staff indicated that they take great care in ensuring that all edges are properly sealed so that tenants cannot grab the edge of a mat and peel it back. In the few cases where mat and encapsulant have been peeled from the surface, the area is repaired using the same encapsulant system and good practices for preventing exposure of workers and tenants to possible lead hazards. Figure 15 shows an example of what it looks like when the encapsulant and mat are peeled from the wall. In this instance, the inspection team peeled a sample from the wall in the unit that was damaged by a car crashing into the building.

Exterior metal porch posts

Metal porch posts in Knoxville were encapsulated with a reinforced two-part encapsulant product in 1988 after lead was detected on the posts. Some posts have been overcoated with paint over the years for color change. Others are still the original gray or beige encapsulant

color. Many posts in the Lonsdale site had intact coatings on the upper half to two-thirds as shown in Figure 16. The lower portion of the posts (under 48 inches) showed wear from abrasion and impact. In Figures 17 and 18, paint is chipping off to reveal gray encapsulant tightly adhered to the metal substrate. Some cracking in the gray encapsulant can be seen in areas of underlying rust.

At the Western site in Knoxville, the porch posts on some units were in much poorer shape. A Western post in relatively good condition is shown in Figure 19. In contrast, Figures 20 and 21 show deteriorated paint and encapsulant cracking and chipping from a post. Paint chips collected at this site point to a loss of adhesion between the substrate and the underlying green paint. The encapsulant appears to be adhering to the paint. However, in some spots the encapsulant had peeled from the underlying green paint, which was still attached to the metal substrate. Cracks can be seen through the encapsulant and the paint down to the substrate. Chipped areas on the lower post show some areas where encapsulant has lost adhesion to the underlying paint and some where paint and encapsulant have chipped off together.

Exterior wood porch posts and siding

On the Carlisle Army Barracks, historic wood porch posts have been recently encapsulated with elastomeric encapsulant. At this early stage (19 months), adhesion is tight and general appearance good, as shown in Figure 22. Adhesion appears good on historic siding, shown in Figure 23.

Exterior brick and cut stone

In Figures 24 and 25, elastomeric encapsulant has been coated on historic brick and cut stone to encapsulate lead-based paint. The encapsulant appears to be tightly adhered. Texture and spalling details are visible in the historic brick. Methods of lead paint removal were damaging to the historic substrates so the previously painted substrates were encapsulated. These applications are less than three years old. In Figure 26, impact damage can be seen on a corner in a high traffic area by the front door. Figure 27 shows some abrasion on the edge of the stone window ledge. The ledge is on a narrow porch and may get wear from the backs of porch chairs.



Figure 6. Encapsulated and painted metal stair risers

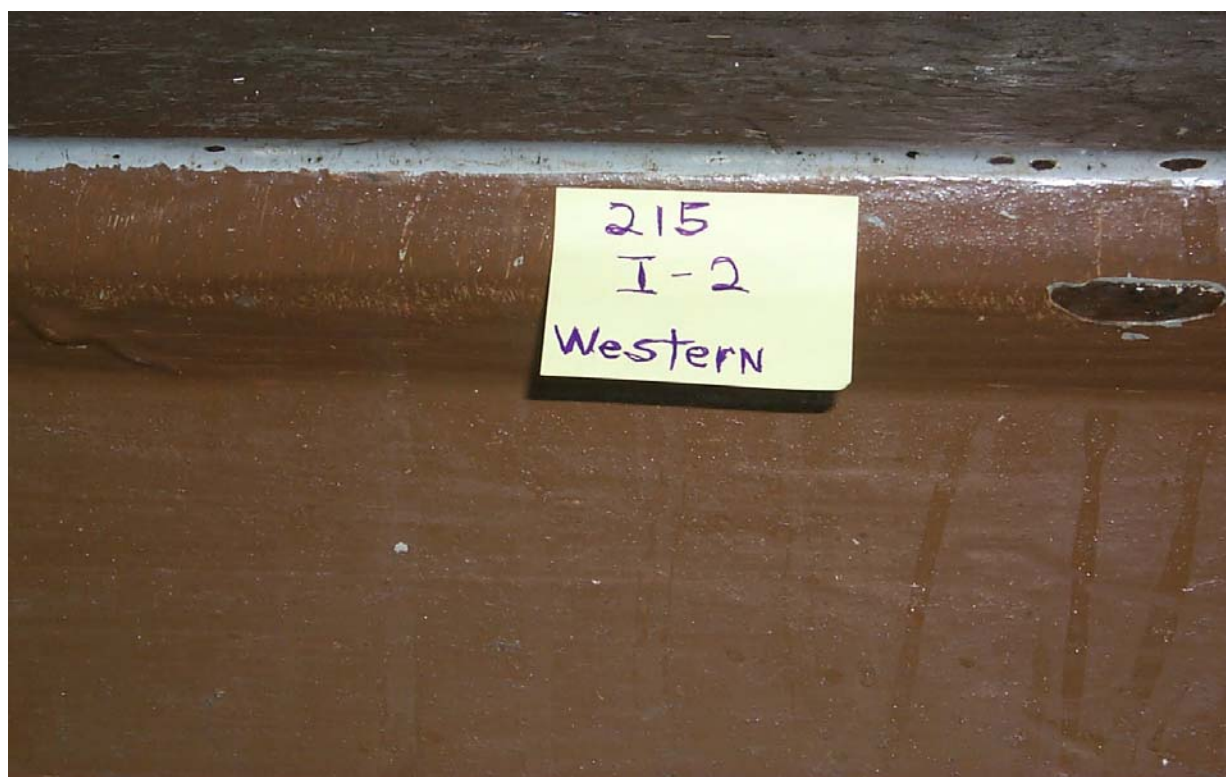


Figure 7. Gray encapsulant on stair edge



Figure 8. Encapsulated wall showing corner impact damage



Figure 9. Encapsulated wall intact after 7 years



Figure 10. Encapsulant cracked due to moisture in cement wall



Figure 11. Encapsulated wall showing peeling encapsulant



Figure 12. Encapsulated wall intact after 15 years



Figure 13. Encapsulated wall intact after 15 years



Figure 14. Encapsulated wall showing corner impact damage in high traffic area



Figure 15. Area where encapsulant and mat have been peeled from wall



Figure 16. Metal porch post encapsulated in 1988, original encapsulant color



Figure 17. Lower portion of post showing wear from abrasion and impact



Figure 18. Encapsulant chipping to reveal underlying gray paint



Figure 19. Metal porch post encapsulated gray in 1988



Figure 20. Base of post showing vertical cracking down to metal substrate



Figure 21. Porch post showing chips down to rusted substrate



Figure 22. Historic wood porch post encapsulated in 1999



Figure 23. Historic wood siding encapsulated in 1999



Figure 24. Historic brick and cut stone encapsulated in 1999



Figure 25. Historic brick encapsulated in 1998



Figure 26. Encapsulated historic brick showing corner impact damage



Figure 27. Encapsulated window ledge showing minor damage

8.0 DISCUSSION AND RECOMMENDATIONS

Based on this limited reconnaissance effort, it appears that the use of encapsulants is not a widely used method of abating lead-based paint hazards throughout the country. As can be expected, the majority of encapsulant users are located in regions of the country typically associated with lead-based paint hazards (e.g., Northeast, Southeast, Great Lakes states). However, even in these areas of the country, the use of encapsulants is strongly influenced by local beliefs and regulations (e.g., Massachusetts and New York City have very restrictive laws governing the use of encapsulants). It also appears that the limited availability of most encapsulants has an effect on encapsulant choices for many users. A contributing factor to this is that coatings (paints and encapsulants) are often produced and used within a limited geographical area.

Although this study was not based on a statistically representative sample from all users and lead hazard control professionals throughout the country, survey results indicate some common themes across the various categories of users and professionals interviewed that provide a picture of the current state of encapsulant usage in the country. These themes include:

- Encapsulation is most often used when components cannot be replaced because of cost, liability, historical preservation, or structural concerns. If it is a feasible option, most users and professionals would rather remove components than encapsulate them.
- Users that have applied encapsulants are generally satisfied with their performance and would use them again in the future if the situation were appropriate.
- Professionals that advise others on encapsulant usage have access to the information necessary to make educated decisions.
- Some of the surveyed users and professionals in the western half of the country and in the Air Force feel that high quality paints are just as effective as encapsulants and that the extra cost of encapsulants does not justify their use.

One of the objectives of the entire reconnaissance effort was to provide input to a possible design of a long-term study of encapsulants. The interviews and site visits conducted during this effort shed some light on the possibilities of such a study. Some ideas on possible design issues are discussed below.

In general, historic buildings are potentially good sites for a prospective long-term evaluation of encapsulant performance in the field, as they will not be subject to demolition or extensive renovation (with component removal) in the future. Unlike other housing units where encapsulants have been used, these historic buildings should be available for periodic evaluation of encapsulant performance far into the future. However, based on the results of this survey, it appears most of the applications of encapsulants to historic buildings have been made in the last three years, making a retrospective study of performance in the near term difficult.

Some of the PHAs that continue to actively use encapsulants also may provide good sites for a long-term evaluation. These sites represent applications of encapsulants that are subjected to much more physical abuse than would be seen in historic buildings. Performance of encapsulants in these more extreme circumstances should be evaluated in any long-term study of encapsulants. The age of applications of encapsulants in these PHAs ranges from 15 years to less than 1 year; thus, it may be possible to evaluate encapsulants at various stages of their life cycle.

One challenge in identifying possible sites to include in a long-term study is personnel turnover. If adequate records are not maintained and annual monitoring is not performed, it is possible that new personnel may have no idea which exact surfaces have been encapsulated, or even if encapsulation was performed at all. These personnel also may not know specific details of the encapsulant application (e.g., when and where it was applied, what product was used, etc.). This potential problem applies to both the military installations (which have very high turnover, but possibly better maintenance practices) and PHAs.

It may be very difficult to locate possible sites in all geographic regions of the country. The majority of encapsulated sites appear to be located east of the Mississippi River. In addition, many individual brands of encapsulant are sold in just one local area; thus, it may not be possible to evaluate effects of climate differences on many encapsulants. Another challenge with identifying possible sites is that some of the oldest applications of encapsulants are now being demolished or extensively remodeled, thus eliminating them from possible consideration.

Decisions concerning what sites to consider also would depend on which encapsulant products would be allowed in the study. Many of the original encapsulant manufacturers, including some of the major manufacturers from the early 1990s, are no longer in business or no longer sell encapsulant products. If the study design would be limited to encapsulants that are currently available, many older sites could not be included in the long-term study.

Finally, there are many technical issues that would need to be considered before conducting a long-term study of encapsulants. Some of these include:

- Assessment of original surface preparation prior to encapsulation - Correct surface preparation is one of the keys to good adhesion and performance of any coating. Note that it may not be possible to assess the surface preparation due to lack of records, current condition of surface, technology limitations, etc.
- Evaluation of peeling of encapsulant or paint - Peeling would have to be evaluated carefully in terms of where delamination occurred. The encapsulant may bond to the underlying paint layers better than the underlying paint layers are bonded to the substrate.
- Importance of any lead found on the surface - Such lead could be from sources such as household dust, the atmosphere, or from cracking and chalking of the encapsulant. It would probably be best to confine investigations to the physical condition of the

paint and encapsulant layers due to the inability to prove the source of any lead found on the surface.

- Importance of any observed impact damage - Such damage could be from normal wear and tear (which might indicate that the encapsulant has performance problems) or from severe tenant and/or landlord abuse (which no encapsulant may be able to withstand).
- Use of ASTM performance criteria in evaluating encapsulants - Most of the ASTM tests for encapsulants are not evaluated by field tests. Instead, they require laboratory tests using special panels on which encapsulants are applied.
- Considerations for site and component selection - Possible considerations include geographical region, type of encapsulant (with versus without mat, latex versus epoxy, etc.), date of application, encapsulated surfaces within unit (interior versus exterior, windows versus walls, etc.), and existence of overcoat.
- Procedures for repairing any damage to the encapsulated surfaces that would occur during sampling - Personnel to do the repairs would have to be identified, along with other personnel who could certify that repairs are done correctly so that tenants are not subjected to lead-based paint hazards.

9.0 REFERENCES

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APPENDIX A

CONTACT INFORMATION

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Table A-1. Current Lead-Based Paint Encapsulant (and Related) Manufacturers

Encapsulant Manufacturer	Address	Phone Number and Website	Encapsulant Product(s)
American Coatings Corporation	3037 NW 60 th Street Ft. Lauderdale, FL 33309	954-970-7820 / 800-533-0151	CC-2B
Coronado Paint Company	308 Old County Road Edgewater, FL 32132	386-883-4193 / 800-323-0633 www.coronadopaint.com	LEAD BLOCK™
Dumond Chemicals	1501 Broadway New York, NY 10036	212-869-6350 www.dumondchemicals.com	LEAD STOP™
Dynacraft Industries, Inc.	28 Harrison Avenue Suite 238 Englishtown, NJ 07726	732-792-2001 / 800-922-0621 www.dynacraft-btn.com	Back To Nature Protect-A-Coat™ Back To Nature Exterior™
Encap Systems Corporation	314 North Parromore Orlando, FL 32801	407-649-4770 www.encapunity.com	EncapSeal™ I EncapSeal™ II
Fiberlock Technologies, Inc. ¹	150 Dascomb Road Andover, MD 01810	978-623-9987 / 800-342-3755 www.leadSAFE.com / www.fiberlock.com	Child GUARD interior/exterior L-B-C® Type III
FLEXi-WALL Systems	208 Carolina Drive P.O. Box 89 Liberty, SC 29657-0089	864-843-3104 / 800-843-5394 www.flexiwall.com	Faster Plaster™ Plaster in a Roll™
Fox Industries	3100 Falls Cliff Road Baltimore, MD 21211	410-243-8856 / 888-760-0369 www.fox-ind.com	FX-499
Global Encasement, Inc.	132-32 nd Street Union City, NJ 07087	201-902-9770 / 800-266-3982 www.encasement.com	LeadLock™
Grace Construction Products	2601 Commerce Blvd. Irondale, AL 35210	205-956-9545 / 800-334-8796 www.graceconstruction.com	Lead Seal® Encasement Barrier Coat® II
Grayling Industries, Inc.	1008 Branch Drive Alpharetta, GA 30201	770-751-9095 / 800-635-1551 www.graylingindustries.com	CONTROL Multi-Use Encapsulant
hallman/lindsay Quality Paints	1717 N. Bristol Street P.O. Box 109 Sun Prairie, WI 53590	608-834-8844 / 888-331-5330 www.hallmanlindsay.com	WHITE POLYMER #500
Insl-x Products Corporation	50 Holt Drive P.O. Box 694 Stony Point, NY 10980	845-786-5000 www.insl-x.com	INSL-CAP™

Table A-1. Current Lead-Based Paint Encapsulant (and Related) Manufacturers (continued)

Encapsulant Manufacturer	Address	Phone Number and Website	Encapsulant Product(s)
Newtex Industries, Inc.	8050 Victor-Mendon Road Victor, NY 14564-9122	585-924-8982 / 800-836-1001 www.newtex.com	Newtex Wallcovering
Proko Industries	501 South Foote Street Cambridge City, IN 47327	765-478-3601 / 800-423-8341 www.proko.com	SAF-T-SHIELD®
SAFE Encasement Systems	7860 Dana Point Court Las Vegas, NV 89117-1927	702-360-6111 / 888-277-8834 www.safeencasement.com	SE-120 Protective Skin
Specification Chemicals, Inc.	824 Keeler Street Boone, IA 50036	515-432-8256 / 800-247-3932 www.spec-chem.com	NU-WAL® #2500 Coating

1 As of January 2000, Fiberlock is manufacturing only the two products listed. Previous products (e.g., L-B-C® Type I, L-B-C® Type II, and LeadMaster®) will continue to be available until inventory is depleted.

Table A-2. Contact Information for PHA Representatives Interviewed During Survey

Region	Public Housing Agency	Contact Name	Phone Number	Title/Position
North East	Albany, NY	Laura Moody	518-445-0711	Office of Modernization
	Cambridge, MA	Jen Faigel	617-864-3020	Planning Department
	Chelsea, MA	Frank Buzderewicz	617-884-5617 ext. 34	Modernization Coordinator
	New York, NY	Jason Krantz / Pat Bree	718-707-5225 / 718-707-5869	Assistant Coordinator of Lead Detection and Abatement Unit
	Philadelphia, PA	Steve Minichuk	215-684-5032 (cell)	Chief of Painting Department
	Pottstown, PA	Rhonda Heckman	215-646-2772	Director of Modernization and Development
	Reading, PA	Dave Talarico	610-775-4813	Maintenance Superintendent
	Troy, NY	Warren Brown	518-273-3626 ext. 23	Comprehensive Grant Program
South East	Chattanooga, TN	Doug Rinn	423-752-4163	Maintenance Supervisor
	Durham, NC	Kelvin Macklin/ Mark Bell	919-683-1551 / 423-752-4839	Maintenance/Construction Specialist
	Gastonia, NC	Sam Murphy	704-864-6771	Maintenance Director
	Greensboro, NC	Peter Clark	336-378-5904	Division of Capitol Improvement
	Knoxville, TN	John Rochelle	865-594-8800	Maintenance Administrator
	Laurens, SC	Bill Porter	864-984-0578 ext. 221	Executive Director
	Orlando, FL	Wayne Carver	407-648-0002	Lead Abatement Supervisor
	Tampa, FL	Terry Brady	813-253-0551 ext. 363	?
North Central	Cleveland, OH	Gerald Ford	216-361-3749 ext 110	Paint Foreman/Supervisor
	Grand Rapids, MI	Andy Taylor	616-235-2600	?
	Indianapolis, IN	Cathy Young	317-261-7200	Inventory Control Coordinator
	Kokomo, IN	Dan Hahn	765-459-3162	Maintenance Facilities Manager
	Lincoln, NE	Al Andrews	402-467-2371	Coordinator of LBP Abatement Projects
	Milwaukee, WI	Eugene Pierce	414-708-9187 (cell)	Project Manager of Parklawn
	Minneapolis, MN	Adam Nguyen	612-342-1406	Project Manager for all remodeling activities
	Oak Creek, WI	?	414-768-6500	?
	Rockford, IL	Mike Bauch	815-987-3830	Contract Manager
	Romulus, MI	? (receptionist)	734-729-5389	?
	St. Paul, MN	Les Sarner	651-298-5664	?
	Toledo, OH	Keith Lavarar	419-259-9465	Maintenance

Table A-2. Contact Information for PHA Representatives Interviewed During Survey (continued)

Region	Public Housing Agency	Contact Name	Phone Number	Title/Position
South Central	El Paso, TX	Frank Sims	915-849-3815	Radiation Safety Officer
	Helena, AR	Lionell Moss	870-338-3407	Executive Director
	Hattiesburg, MS	Madeleine Hose	601-583-1881	?
	New Orleans, LA	Clifton Jones	504-670-3407	Director of Housing and Operations
North West	Boise, ID	Bob Fowler	208-345-4907	Inspections
	Butte, MT	Revonda Stordahl	406-782-6461	Executive Director
	Cheyenne, WY	Polly Fisk	307-634-7947 ext 333	?
	Everett, WA	Ginger	425-258-92222 ext. 3	Maintenance
	Helena, MT	George Marble	406-442-7970	Executive Director (previously Maintenance Supervisor so has first-hand knowledge)
	King County, WA	Mike Reilly	206-574-1154	Housing Management Operations Manager
	Portland, OR	David Walter	503-802-8300	Assistant Director of Housing
	Salem, OR	Terry Frasier	503-588-6368	Administrative Analyst
	Salt Lake City, UT	Reed Robinson	801-487-2161 ext. 1241	Modernization Coordinator
	Seattle, WA	Emmett Moore	206-615-3520	Construction Program Manager
	Tacoma, WA	Robert Paulson	253-207-4400	Project Manager for Modernization Office
	Denver, Co	Mark Ward	720-932-3000	Abatement and Capitol Improvements
South West	Marin Co., CA	Craig Dodson	415-491-2525 415-720-9452 (direct)	Manager of facilities and systems
	Phoenix, AZ	Dave Untied	602-262-4494	Maintenance Supervisor for the Field
	Santa Clara, CA	Scott Schnell	408-993-3087	?

Table A-3. Contact Information for Military Installation Representatives Interviewed During Survey

Region	Military Installation	Contact Name	Phone Number	Department
North East	Carlisle Barracks, PA	William Vogel	717-245-3823	Department of Public Works
	Fort Dix, NJ	Ken Smith	609-562-5325	Environmental Office
	Indian Head Naval Station, MD	Nancy Williams	301-744-4609	Housing Office
South East	Elgin AFB, FL	Mike Spaits	850-882-2878	Environmental Engineering
	Fort Bragg, NC	Harry Miller	910-436-1778	Housing Maintenance and Painting
	Fort Knox, KY	Mike House	502-624-8476	Environmental Office
North Central	Wright-Patterson AFB, OH	Dan Cruz	937-253-3488	Maintenance & Contracting
South Central	Fort Sam Houston, TX	David Walker	210-221-4842	Environmental Office
	Fort Sill, OK	Tom Szcepanski	580-442-6015	Environmental Engineering
	Tinker AFB, TX	Mark Patterson	405-736-3597	Environmental Engineering
North West	Fort Lewis, WA	Frank Crowne	253-967-2326	Environmental and Natural Resources
	Malmstrom AFB, MT	Don Geetz	406-731-7227	Environmental Engineering
South West	East Fort Baker, CA	Frank Crowne	253-967-2326	Environmental and Natural Resources
	Fort Irwin, CA	Justine Vishart	760-380-3743	Environmental Division

Table A-4. Contact Information for Other Lead Hazard Control Professionals Interviewed During Survey

Region	Organization	Contact Name	Phone Number	Title/Position
North East	Conner & Associates	Tim Conner	410-296-7971	Risk Assessor
	Redevelopment Authority of Cumberland Country	Bob Leonard	717-249-0789	Housing Specialist
	ASTM / NIST	Mary McKnight	301-975-6714	Subcommittee Chair
	LVI Environmental Services	David Rymers	301-840-8898	President
	Naval Facilities Engineering Command	Thom Snyder	610-595-0567	Industrial Hygienist
South East	Solutions Associates	Gregory Dyson	404-349-9600	Engineer
	Richmond Department of Public Health	Michael Graham	804-646-3284	Abatement Supervisor
	Savannah Department of Housing, Rehabilitation	Carl Newsome	912-651-6517	Construction Specialist
	NLAAC	Ken White	757-499-4420	Trustee
North Central	Lawhon & Associates	Mike Craig	216-737-0100	Manager
	independent contractor	Haskell Fought	614-424-4392	Owner
	Lawhon & Associates	William Jacowitz	614-818-5200	Risk Assessor
	City of Milwaukee	Robert Jacoby	414-286-5442	Environmental Control Manager
	U.S. Army - CERL	Ashok Kumar	217-373-7235	Project Leader
	Toledo Redevelopment Authority	Drew Sager	419-936-3633	Housing Reviewer
South Central	Calco Lead Hazard Inspectors	Steve Calonje	504-367-8100	Risk Assessor
	Mississippi Bureau of Health	Keith Maranger	601-906-8891	Lead Program Specialist
North West	Prezant Associates	Bob Bliss	206-281-8858	Lead Trainer
	Techcon Inc.	Chris Edison	509-536-0406	Risk Assessor
South West	On the Mark Environmental Consulting	Mark Guatney	602-526-9618	President
	Historic Resources Group	Peyton Hall	323-469-2349	Architect
	Navel Facilities Engineering Command	Daniel Zarote	805-982-1057	Coatings Chemist

APPENDIX B

SURVEY SCRIPTS

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Table B-1. Interview Script Used for Survey of Major Encapsulant Users

Hello. This is <interviewer name> with Battelle Memorial Institute in Columbus, Ohio. We are working with HUD to survey various users of lead-based paint encapsulants. As a user of liquid-applied encapsulants, would you be able to respond to a few questions about your experiences?

Name _____ Company _____

Title _____ Address _____

Phone No. _____

Years with Company _____ Years Using Encapsulants _____

Region: Northeast Southeast North Central South Central Northwest Southwest

Type of User: PHA Military Installation Homeowner Contractor Other

If Other _____

1. Have you used encapsulation as a tool to reduce leaded paint hazards in any residential housing?
2. Under what conditions would encapsulants not be considered appropriate for use?
3. What percentage of your lead-hazard control work involves the use of encapsulants?
4. Estimate the number of times that you have used encapsulants.
5. Did you refer to Chapter 13 of the *HUD Guidelines* for advice when deciding on possible encapsulant use?
6. How did you decide which encapsulant product to use?
7. Have you used more than one type or brand of encapsulant?
8. How would you describe your experience with preparing and applying an encapsulant product?
9. Did you perform the patch test suggested in the *HUD Guidelines* prior to applying the encapsulant?
10. Since the encapsulant was applied, has it been painted over with one or more layers of conventional paint?
11. How well has the encapsulant performed since it was applied, especially in terms of durability and appearance?
12. Did you have the information that you needed for selection and use of encapsulant systems?
13. Will you use encapsulants in the future?
14. Do you have any units where you have applied or are going to apply encapsulants that could be visited?

Table B-2. Interview Script Used for Survey of Other Lead Hazard Control Professionals

Hello. This is <interviewer name> with Battelle Memorial Institute in Columbus, Ohio. We are working with HUD to survey various users of lead-based paint encapsulants. As a professional who may provide advise concerning the use of liquid-applied encapsulants, would you be able to respond to a few questions about your experiences?

Name _____ Company _____

Title _____ Address _____

Phone No. _____

Years with Company _____ Years In Lead Hazard Field _____

Region: Northeast Southeast North Central South Central Northwest Southwest

Type of User: Risk Assessor Lead Trainer Environmental Consultant Other

If Other _____

1. Please describe your role regarding advising homeowners or professionals in the lead hazard control field.
2. Do you provide information on LBP encapsulation as a tool for reducing lead-based paint hazards?
3. Do you refer homeowners and professionals to Chapter 13 of the *HUD Guidelines* for advice on the proper use of encapsulants?
4. What percentage of the time do you recommend/use encapsulants when conducting lead hazard reduction activities?
5. Do you have the information that you need about the selection and use of encapsulants?
6. What types of information do contractors and other professionals in the lead-based paint community request from you on the use of LBP encapsulation?
7. Please estimate, based on your professional judgment, the extent of the use of encapsulants for the reduction of lead-based paint hazards?
8. Do you think that use of encapsulants varies from one geographical area to another?
9. What is your experience or perception of the effectiveness of encapsulation?
10. Do you expect the use of encapsulation to increase in the future?
11. What training have you received concerning lead hazard controls?
12. Would you like to receive a copy of the final report at the conclusion of the study?

APPENDIX C

SELECTED SURVEY RESPONSES

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Table C-1. Responses for Selected Questions Asked of PHA Representatives

Public Housing Agency	Use encapsulants?	Why?	When?	Where?	How is it holding up?	Would use product again?	How was product found?
NE - 1	Yes	It was recommended by the consultant on the project.	7 years ago	?	Held up great. Little or no deterioration.	If recommended.	Recommended by consultant on the project.
NE - 2	Yes	Small area where easily applied. Encapsulation recommended by lead consultant.	1992-1994	Small area above sink and below cabinet.	Holding up well.	Yes, but if can remove lead then prefers to do that and then doesn't have to worry about it any more.	Lead consultant on project specified info and contractor recommended Kapsulkote.
NE - 3	Yes – used to	So much LBP that couldn't remove it all quickly enough. Now do not use it because city Health Department must approve abatement method and they don't like encapsulation.	In the past.	? Dept restructured in '96 so not aware of specifics.	Not monitoring it, in the process of removing all LBP and encapsulants.	No.	?
NE - 4	Yes	Experimented with various encapsulant products and liked Insl-x best.	>6 years	Every site has it. Product acts as both encapsulant and paint, so quick process when sprayed on.	Pleased with how it is holding up, especially against leaks.	Yes, still using it weekly.	Trial and error process with various products. Proud of experimentation done.
NE - 5	No	Not had to deal with lead since the contact had been there, only asbestos problems. Prior persons may have dealt with lead but are no longer there.					

Table C-1. Responses for Selected Questions Asked of PHA Representatives (continued)

Public Housing Agency	Use encapsulants?	Why?	When?	Where?	How is it holding up?	Would use product again?	How was product found?
NE - 6	No	Tried them, had a model home in which they tested a wide array of products. Were not pleased with any of them and how they held up (did like Encap but it is no longer in business). Especially hard to use encapsulants given the strict state laws. They remove LBP instead.					
NE - 7	Never – contact said he'll always remove it.	State laws so strict that it is easier to remove it. So much room for error in application, and test to pass is so strict it is easy to fail the test.					
SE - 1	Yes	?	Started 1988 /1990	Handrails, closet shelves, and closet cleats.	Good, better in closets than on handrails.	No need, all done.	At a meeting set up by HUD at which encapsulant manufacturers were introduced to HA representatives.
SE - 2	Yes	Used on areas where couldn't remove paint.	?	Soffits and fascia, which are encapsulated and then encased in vinyl or aluminum.	Doing fine, no dust. Maybe due to encasement.	If needed.	Contractor made product decision.
SE - 3	Yes	?	Used in a prior time, before contact had started working there. Project now set for demolition.	? not monitored because in a project set for demolition.	Not monitored because in a project set for demolition.	Not enough info to know if performed well.	? Before his time.

Table C-1. Responses for Selected Questions Asked of PHA Representatives (continued)

Public Housing Agency	Use encapsulants?	Why?	When?	Where?	How is it holding up?	Would use product again?	How was product found?
SE - 4	Yes	Because quick and simple.	14+ years	Porch poles.	Does not fare well. Kids pick it off with hands.	No, better to remove lead and not have to worry about it.	Contractor.
SE - 5	Yes	?	1988	Interiors, stair risers, porch rails.	Good. Some porch rails chipped.	Yes, he'd see what products are available now.	At one of the housing shows.
SE - 6	Yes	Used on areas where couldn't remove paint.	5+ years (before his arrival).	Used on soffit and fascia and then covered with vinyl or aluminum.	Working fine, can't see it since enclosed in vinyl or aluminum.	Yes, cheaper than other types of abatement.	Architect decided to use encapsulant and an environmental consultant reviewed the products available on the market.
SE - 7	No	Components that had been encapsulated (doors and jams) are being removed now. Contact knows of no other projects using encapsulants. They have done no monitoring in his tenure there.					
SE - 8	No	They looked at using encapsulants on a recent project, but the price difference was so small that they went with removal so they wouldn't have to worry about it in the future. Looked at a Global Encasement product and were pleased with the product.					
NC - 1	Yes	Concrete bldg. Couldn't remove LBP easily.	10 years ago.	Painted everything.	Holds up well until someone puts a hole in the wall.	Yes	? Decision made before his time.

Table C-1. Responses for Selected Questions Asked of PHA Representatives (continued)

Public Housing Agency	Use encapsulants?	Why?	When?	Where?	How is it holding up?	Would use product again?	How was product found?
NC - 2	Yes	Cost	?	Walls (concrete), wood doors and windows.	Good	Now they use a paint product, "more durability and elasticity" than encapsulants.	?
NC - 3	Yes	Consultant recommended it.	Just started using product last year.	Mostly walls, sometimes radiators.	Pleased thus far with appearance.	Yes	Contractor recommended. Saw coke bottle test & were impressed.
NC - 4	Yes	Too costly with other methods	'86-'89, still use it today to touch up.	Walls and ceilings.	Very well	Yes, still do.	Researched themselves and found it.
NC - 5	Yes	Too expensive to remove components with LBP.	10 years ago	Baseboards	Fairly well. A few damaged spots but only on top layer.	Sure	Can't remember.
NC - 6	No	They said they had no LBP in their housing and never had.					
NC - 7	No	Only housing project was built in 1986, so no LBP.					
NC - 8	No	No, tried them but could not get them to pass the patch test. They tried several products. Problem was with paint-to-paint adhesion, not encapsulant to paint adhesion. Paint separates from paint during patch test. They instead remove the paint or enclose it when can't remove components. They would use encapsulants if they could find a product that would permeate all the layers of paint and be able to pass the test.					
NC - 9	No	Did consider encapsulants 8 years ago, but decided to remove LBP because were not pleased with the encapsulant products available then.					
NC - 10	No	They did experiment with encapsulants (both paint-on and fiberglass products) when they came out 10 years ago, but found them inferior. Instead, they either remove or strip the LBP.					
NC - 11	?	Contact did not know of any. He was new at his job, only been there 3-4 months. Knows of no one to ask since many people in that area have retired.					

Table C-1. Responses for Selected Questions Asked of PHA Representatives (continued)

Public Housing Agency	Use encapsulants?	Why?	When?	Where?	How is it holding up?	Would use product again?	How was product found?
SC - 1	Yes	Recommended by contractor.	1993	?	It has held up fine, no problems.	Yes, as long as HUD continues to recommend encapsulants.	Recommended by contractor.
SC - 2	Yes	Have a lot of historical housing and cannot remove components without matching existing, which is cost prohibitive.	8 years	Many different places.	They've performed well.	Yes. Especially with historical components.	?
SC - 3	No	Contact knows of no encapsulant usage in the housing authority. Are working on a project now and have decided to remove lead instead of encapsulating, so that they won't have to worry about it or monitor it.					
SC - 4	No	They are coating LBP with a paint product called OKON Paintbooster. Product is not an encapsulant. It was bought for its ability to reduce paint peeling from H ₂ O and moisture. They found it through a paint dealer and it seems to be reducing the peeling of paint. Did not seem to be aware of encapsulant products on the market and asked for manufacturers' information. Said they had a limited budget for researching products.					
NW - 1	Yes	Due to cost and because they have some historical components.	7 years ago.	?	Still looks good.	Yes	? Guy who made that decision has since left.
NW - 2	No	They have not used encapsulants, not even as interim controls. They prefer to remove the LBP or to paint over the LBP, but don't use an encapsulant product. They do clearance testing afterward. They do annual and semi-annual monitoring of LBP. Some projects are entirely demolished and rebuilt, thereby removing the LBP hazard. Contact did not like encapsulants because doesn't think they wear any better than paint, and encapsulants cost twice as much. He has seen modern encapsulants, but is not impressed with them.					
NW - 3	No	Have instead removed LBP on interior surfaces and enclosed LBP on exterior behind vinyl siding. Have not had much LBP since, so not worth researching alternative methods.					

Table C-1. Responses for Selected Questions Asked of PHA Representatives (continued)

Public Housing Agency	Use encapsulants?	Why?	When?	Which product?	Where?	How is it holding up?	Would use product again?	How was product found?
NW - 4	No	Soffits encased with plywood. LBP components were removed and replaced. They did not have much LBP to remove; only 2 old houses and a duplex.						
NW - 5	No	All LBP has been removed 4-5 years ago.						
NW - 6	No	No LBP now. Newer housing or LBP was removed in past renovations.						
NW - 7	No	Exterior LBP encased in metal. On the interior they removed and replaced components that had LBP. Encasement was done before the lead laws changed. They realized that there were encapsulant products at the time they did the interior abatement, but they knew that HUD frequently changed their minds so they chose to remove the LBP from interiors. Products available at that time did not appeal to them.						
NW - 8	No	Used enclosure method instead. Vinyl siding has been applied over LBP on exterior of building.						
NW - 9	No	All LBP was removed in the past. Encapsulants were used on asbestos. The contact did not know if encapsulants for lead were considered in the past since the personnel had changed.						
NW - 10	No	Contact had no familiarity with encapsulant products. LBP is not a big problem there.						
NW - 11	Not yet, have just specified the Global Encasement product in a new contract.	Cannot remove LBP from walls.	Have just specified in new contract.	Walls. All LBP has been removed from components such as trim, baseboard, window, sills, doors, jams, etc. Some exterior siding is also being removed.		N/A	N/A	Found product through a brochure obtained at a conference. They then had the product demonstrated.
SW - 1	Yes	?	About 2 years.	Only on exterior; on interior, LBP is removed.		Good surface, not blistered. It has been retouched since first application.	Yes	Low bid process. Product had to meet specifications provided.
SW - 2	Yes	Recommended by lead consultant.	About 5 years ago.	On interior ceilings (over leaded varnish) and on exterior.		Held up well, even on outside with the elements.	Yes	Recommended by lead consultant.

Table C-1. Responses for Selected Questions Asked of PHA Representatives (continued)

Public Housing Agency	Use encapsulants?	Why?	When?	Where?	How is it holding up?	Would use product again?	How was product found?
SW - 3	Yes	?	1995-1996	Soffits and fascia.	Not significantly deteriorating.	No, if they can't remove it now, then they enclose it in vinyl siding.	They specified needs and contracted out for product.
SW - 4	No	Prefer to remove it. They are a newer housing authority, so very little lead. Oldest building they have is 25 years old and the lead found in it was all removed.					

Table C-2. Responses for Selected Questions Asked of Military Installation Representatives

Military Installation	Use encapsulants?	Why?	When?	Where?	How is it holding up?	Would use product again?	How was product found?
NE/SE - 1	Yes (On CERL list for encapsulation)	Officers housing on historic register so exterior surfaces have to be abated in place. The old brick does not stand-up to stripping.	Started in summer of 1999 and continues. Moving from brick exteriors to historical wood sided units.	Exterior surfaces of historic buildings.	Excellent condition so far. Adhesion seems good and white remains bright.	Yes. Will do the exteriors of wood-sided units next.	Searched market for lead encapsulant products.
NE/SE - 2	Yes (On CERL list for encapsulation)	Structural exterior porch posts had leaded paint.	about 1999	Porch posts on residential units.	Holding up well. Almost like putting a cast around the poles.	Would do other substrates if needed, but prefer component removal if possible.	Was not part of the selection process so does not know how selected.
NE/SE - 3	Yes	Historic housing exteriors built as early as 1895.	1996	Exterior brick and wood siding of historic buildings.	Two houses peeled so badly that entire surface had to be redone. Others needed only touch-ups.	Only if Historical Society blocked replacement of components.	Allowed contractors and suppliers to demo products on one unit, then selected best for other 22 units.

Table C-2. Responses for Selected Questions Asked of Military Installation Representatives (continued)

Military Installation	Use encapsulants?	Why?	When?	Where?	How is it holding up?	Would use product again?	How was product found?
NE/SE - 4	Yes (On CERL list for encapsulation)	Exteriors of historic housing.	Fall 1997	Exterior siding and architectural detailing.	Holding up well. Monitored during application and immediately after.	Would do other components that could not be removed and replaced.	Contracted through the Center for Public Works in Baltimore, Fiberlock, and recommended contractor.
NE/SE - 5	No	No lead found in most housing units. A few abated about ten years ago by component removal. Some lead in schools, playgrounds, and water towers were abated by component removal under strictest EPA and Florida State Guidelines.					
NE/SE - 6	No (On CERL list for upcoming encapsulation)	To his knowledge, encapsulation has not been used to date at this installation. They inspect unit-by-unit for lead-based paint and remove components having LBP. They are implementing an Army program to privatize older housing (BRAC) that involves transfer to private ownership "as-is".					

Table C-2. Responses for Selected Questions Asked of Military Installation Representatives (continued)

Military Installation	Use encapsulants?	Why?	When?	Where?	How is it holding up?	Would use product again?	How was product found?
NC/SC - 1	Yes	Abate exterior leaded paint on 1950s housing that is slated for destruction in ten years.	Late 1998	Exterior wood siding with small amount of brick.	Excellent and improved appearance too.	Yes. Will be using on some historical units and some interiors in future.	Had work done under CERL contract because simplified process and ensured experienced applicator, not just lowest bidder.
NC/SC - 2	No	Some housing 1920s-1940s had some leaded paint identified. As a rule, components were removed. Intact painted surfaces such as walls and ceilings are very well maintained with high quality paint. No scraping. Guidelines for abatement could be less complicated and related to real world.					
NC/SC - 3	No	General policy is to remove components having LBP where possible and enclose where not possible. Found lead only on some carports which were then enclosed with plywood. No lead based paint was found in the interiors of the 1958-69 built housing.					
NC/SC - 4	No	Waiting for approval of plan for paint assessment and abatement (if needed) for leaded paint for 3300 housing units. No use of encapsulant in the past.					
NW/SW - 1	Yes	Historic buildings being donated to Park Service.	Late 1998	Exteriors	Good	Would use again on historic structures where components cannot be removed.	Private contractor applied.
NW/SW - 2	No	Pre-1970s housing units.	Late 1998	Exteriors	Good	Would use again if no money for component removal.	Private contractor applied.

Table C-2. Responses for Selected Questions Asked of Military Installation Representatives (continued)

Military Installation	Use encapsulants?	Why?	When?	Where?	How is it holding up?	Would use product again?	How was product found?
NW/SW - 3	No	Was not familiar with encapsulant products. In pre-1970s housing some lead was detected on some floor boards, door jambs, garage doors, and handrails. These are being removed and replaced. Might consider encapsulant use on components that cannot be easily removed if had product information. He is new to this field and is going to his first lead abatement class next week.					
NW/SW - 4	No (On CERL list for upcoming encapsulation)	General policy is to remove components or to manage leaded paint in place by covering (T-11 plywood siding, aluminum soffit caps etc.) but are considering lead encapsulants for immediate interim encapsulation when housing was scheduled for renovation or privatizing. None used to date.					

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APPENDIX D

SITE VISIT DATA COLLECTION FORMS

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SITE VISIT FORM - ENCAPSULATION OF LEAD PAINT

<u>DATE</u>	<u>TEAM</u>	<u>CONTACT/LOCATION</u>
<u>SITE</u>		

	<u>Yes</u>	<u>No</u>				
Review site historical records	<input type="checkbox"/>	<input type="checkbox"/>				
Risk assessment	<input type="checkbox"/>	<input type="checkbox"/>				
Paint assessment	<input type="checkbox"/>	<input type="checkbox"/>				
Name of encapsulant						
Generic description						
Date encapsulant applied						
Who applied						
Where applied (please circle)	interior	exterior				
Substrate (please circle)	brick	concrete	drywall	metal	plaster	wood
Building parts covered						
Monitoring schedule (please circle)	6 month	12 month	other			
Repairs needed						
	<u>Yes</u>	<u>No</u>				
Repairs made	<input type="checkbox"/>	<input type="checkbox"/>				
Encapsulant overcoated with paint	<input type="checkbox"/>	<input type="checkbox"/>				

<u>INTERVIEW OWNER/USER</u>			
Why did you use an encapsulant product?			
How did you select a product?			
Did you consult <i>HUD Guidelines</i> or <i>ASTMs</i> ?			
Would you use this product again?			
	<u>No</u>	<u>Some</u>	<u>Many</u>
Have you had complaints about deteriorating encapsulant?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
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13. ABSTRACT (Maximum 200 words) This report summarizes the findings of an effort to determine the extent to which lead-based paint liquid encapsulants are being used for residential lead hazard control and to obtain an informal assessment of users' experiences with encapsulants. The effort included a literature search to identify and review the relevant literature on encapsulant use and performance, interviews with officials from states that were considered to be likely to regulate encapsulant use, surveys of major encapsulant users and other lead hazard control professionals, and site visits to selected users. Specifically, the following was performed: 1. Encapsulant manufacturers were identified from various state registries, Internet searches, exhibitor lists from lead conferences, and advertisements in coatings journals and lead-oriented newsletters. 2. 24 states were contacted regarding their regulation of lead-based paint encapsulant products. 3. Interviews were conducted with selected encapsulant users and other lead hazard control professionals to inquire about their experiences with encapsulation as a viable lead-based paint abatement technique. 4. Site visits were conducted for the purpose of evaluating selected applications of encapsulants in the field.				
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